FOREWORD BY THE MINISTER OF AVIATION

In this report the Committee on the Planning of Helicopter Stations in the London Area have set out the planning criteria and have suggested possible sites for a heliport in central London. They make the reasonable assumption that before long regular passenger services with large multi-engined helicopters will begin to operate between central London and other city centres on the continent and in the United Kingdom. Three possible sites are suggested: Nine Elms Goods Yard, Cannon Street Station and St.Katharine Docks.

During the intervening months since the Committee presented their first report to me, it has been possible to carry further certain of the technical studies on which the Committee had made a start. At my request the Committee have given further thought to the possibilities of mitigating noise by placing the heliport on a high platform or on the roof of a suitably designed high building, and a supplementary report on these possibilities has been added.

Valuable experience has been gained from flying the Rotodyne for the first time last spring into central London, where it landed and took off from the Battersea Heliport.

The attack on the noise problem will continue. There is a comprehensive programme of work by Government establishments and manufacturers into the means of abating noise at source. In the eventual choice of site and in the design of a heliport every advantage will be taken - within inevitable technical limits - of height, of the river and of industrial areas, so as to provide a buffer between the heliport and the nearest residential areas.

I hope that the publication of the report will stimulate constructive criticism and useful suggestions, because I believe that this project is one that will bring great benefits to central London, and may well prepare the ground for the time when London has several heliports and travel by vertical take-off aircraft becomes as widely accepted as travel by fixed-wing aircraft today.

UNIVERSITY CAMBRIDGE 4 AU 1961

Peter Thorneycroft.

MEMBERSHIP

Mr. G.I. Morris, C.B.	Chairman
Mr. P.W. Brooks	British European Airways
Mr. G.W. Quick Smith, C.B.E.[*]	British Transport Commission
Mr. A.J. Shove	London County Council
Mr. L.W. Lane	
Mr. A.J.H. Clayton	
Mr. G.S. Hill	Ministry of Aviation
Dr. G.E. Bell, O.B.E.	
Mr. G.W. Stellibrass, O.B.E.	
Mr. A.H. Watson	
Mr. W.B. Lewis	
Mr. A. Dumeire	
Mr. D.C. Clark	Secretariat
Mr. P.E. Meagher, D.S.O., D.F.C.	
Mr. C.B. Benjamin	

Other officers from our respective organisations and from the Ministry of Transport and the Building Research Station have attended as advisers.

TERMS OF REFERENCE

To formulate the desiderata and consider the possible locations of helicopter stations in the London area on the following alternative assumptions -

A. That the helicopter is developed to the point of offering low enough fares on regular services to attract large numbers of passengers for inter-city flights on international routes and possibly internal ones as well.

B. That the helicopter will not offer fares low enough for mass travel but will meet the needs of small numbers of travellers for whom the extra time saved is more important than money spent.

In the case of the first alternative the Committee should examine the comparative advantages of one central station and of several stations. They should in particular pay regard to the facilities which might be made available in the neighbourhood of railway termini.

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[*] Mr. M.A. Cameron attended a number of meetings on behalf of the British Transport Commission.

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INTRODUCTION

1. We were appointed on 8th July, 1959, by the Minister of Transport and Civil Aviation, after consultation with the London County Council as planning authority, with the following terms of reference:-

> To formulate the desiderata and consider the possible locations of helicopter stations in the London area on the following alternative assumptions -
>
> A. That the helicopter* is developed to the point of offering low enough fares on regular services to attract large numbers of passengers for inter-city flights on international routes and possibly internal ones as well.
>
> B. That the helicopter will not offer fares low enough for mass travel but will meet the needs of small numbers of travellers for whom the extra time saved is more important than money spent.
>
> In the case of the first alternative the Committee should examine the comparative advantages of one central station and of several stations. They should in particular pay regard to the facilities which might be made available in the neighbourhood of railway termini.

2. We held thirty meetings. In the course of these we had the advantage of hearing the views of representatives of national administrations and local authorities, manufacturers and operators of helicopters, and heliport managements and other outside bodies listed below:-

Administration de l'Aéronautique, Belgium
Aéroport de Paris
Municipalité de Bruxelles
Cologne Town Council
Cologne-Bonn Airport Authority
Corporation of the City of London
Fairey Aviation Ltd
Federal Aviation Agency, United States
Federal German Ministry of Transport
General Post Office (by correspondence)
Helicopter Association of Great Britain
London Chamber of Commerce
Civil Aviation Department, Netherlands
New York Airways
Port of New York Authority
Port of London Authority
Rotorports Ltd
Rotterdam Municipality
SABENA
Secretariat Général à l'Aviation Civile et
Commerciale, France
Transport Ministry, North-Rhine Westphalia
Westland Aircraft Ltd
Westland Heliport, Battersea

A full list of those who were kind enough to meet us is given at Appendix A; we wish to record our gratitude to all for their help and advice.

3. We set in train a number of special studies of which the following were major ones:-

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* We have taken the term helicopter to include any type of aircraft capable of taking off without a forward run which could be expected to be available for commercial operation in the foreseeable future.

(a) a study of helicopter noise carried out by a working group;*

(b) a survey of possible sites carried out by officers of the London County Council and the Ministry of Aviation;

(c) a survey of business demand for helicopter services carried out by the London Chamber of Commerce.

4. At an early stage we visited the BEA Helicopter Unit at Gatwick, the Westland Heliport, and - in the course of a tour of the SABENA helicopter network - the heliports of Brussels, Cologne and Rotterdam.

5. We gained first-hand experience of flying in helicopters, not only on the SABENA network, but also in flying from Gatwick to the Westland Heliport in a Westland Whirlwind and a prototype Vertol 107, and in a prototype of the Fairey Rotodyne from White Waltham.

6. Finally, we have inspected nine possible sites in London, including St. Katharine Docks, which we were taken over by the General Manager of the Port of London Authority.

Historical Background

7. The first experiment with a heliport in central London began in 1952 when the Ministry of Civil Aviation opened a two-acre heliport on the Festival of Britain site on the South Bank temporarily made available by the London County Council. The site was used exclusively by small single-engined helicopters. To begin with there were only occasional flights, but in 1954-55 BEA ran experimental scheduled passenger services with eight-seater Westland Whirlwind helicopters between the South Bank and London Airport.

8. Between 1956 and 1959 a number of sites for a permanent heliport, as well as the possible temporary expedient of building a floating platform on the Thames, were considered, but, pending the introduction of commercially attractive helicopters, the airlines made no move to operate regular services from central London and the Ministry considered it premature to secure suitable sites for a permanent heliport.

9. In 1958, however, the Westland Aircraft Company obtained planning permission for a small, temporary one-acre heliport at Battersea. This heliport was opened in April, 1959, and it now handles about forty charter movements a week. Planning permission is due to expire in 1965.

10. In a few countries abroad, regular passenger services with single-engined helicopters have developed to a much greater extent; short-stage services are operated in several cities in the United States, principally between local airports and between city centres and airports; SABENA run a service between cities in Belgium, France, Germany and Holland; and a similar service has recently started in northern Italy. These are described in greater detail in Appendix B.

The Problem and our Approach

11. So far only single-engined helicopters have been available for civil use. Their operating costs are high and, being able to operate only in visual conditions, they cannot offer the regularity of service necessary for successful commercial operation. Their inability to keep flying once an engine has failed means that they should not operate over built-up areas, except along specially chosen routes, nor can they be allowed to carry passengers for long distances over water. For these reasons the helicopter has not yet become a significant factor in civil air transport.

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* The working group was under the chairmanship of Mr. G. W. Stallibrass, O.B.E., Director of Aerodromes (Technical), and included representatives of the Building Research Station, British European Airways, the London County Council and the Ministry of Aviation.

12. A new situation is, however, likely to be brought about by the introduction into civil use within a few years of multi-engined helicopters*. The first of these types are expected to enter service in the United States in 1961, and comparable helicopters are likely to be available shortly afterwards for United Kingdom and European operators. These first multi-engined helicopters would be capable of carrying about 25 passengers between city-centres up to 250 miles apart at speeds of 120 miles per hour or more.

13. It should be possible in due course to bring larger and faster types into operation between London and near continental cities at fares comparable to first class fares on the corresponding fixed wing routes. Regular and frequent services from conveniently placed heliports could be expected to attract traffic from fixed wing services and also create new traffic since the saving in time and money spent at hotels or on the journey between central London and the airport would compensate for the somewhat higher air fares.

14. The small temporary heliport that has so far served the casual requirement in central London will not be adequate for this new requirement. Much greater areas of land will be needed, not only for the pad but even more for the aircraft stands, car parks and the terminal facilities, including Customs. The heliport will need to be equipped with landing aids to enable the helicopters to operate in adverse weather. Finally, multi-engined passenger helicopters could not be expected to climb or descend at gradients much steeper than 1 in 4, and extensive sectors around the heliport will need to be free of obstructions that might prevent their safe landing and taking off - a requirement which is becoming more and more difficult to meet as the number of high buildings in London increases.

15. A permanent heliport within easy access of the residential, hotel and office areas of London will provide a new transport facility which will benefit many but which for others will undoubtedly create problems, of which noise is the most serious. In looking for sites our main concern has been to strike a balance between the needs of the traveller, the needs of safety and the needs of the general community.

16. We have not interpreted our terms of reference as requiring us to study the economics of the various locations. This will be a matter for the promoters of the heliport. Nevertheless we have sought to avoid solutions that might be extravagant, bearing in mind that the heavier the costs of the heliport - costs that will ultimately have to be borne by the users - the more difficult it will be for helicopter services, even with improved types of aircraft, to make themselves self-supporting.

17. We have divided our report into four parts. Part I sets out the traffic estimates on which we have based our plans. In Part II we assess the various criteria governing the size of a heliport. In Part III we discuss the factors which determine the most suitable location; and in Part IV we bring our conclusions to bear on a number of possible sites and offer a short list from which we consider the ultimate choice should be made. At the end of Part IV we deal with the question of how many sites will be needed and with some suggestions concerning the next steps. The following paragraphs contain a summary of conclusions and recommendations.

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* By multi-engined helicopters we mean those types that are able to satisfy the full performance requirements for maintaining flight if one engine fails and which have the required general mechanical reliability to permit regular flights over built-up areas.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

Traffic Prospects - Part I

18. It is assumed that regular services between London and the near continental cities with helicopters carrying 25 passengers or more will begin by 1965 or soon after, that fares will be offered approximating to those of the first class fixed-wing services and that services to provincial cities in the United Kingdom will follow if fares can be reduced to compete with those of other forms of transport. (para. 33).

19. Allowing for executive and charter flights with passengers, freight and mail (para. 34) as well as regular services, the total traffic could amount to 20-25 helicopter movements in a peak hour with a mixture of single- and multi-engined types by 1975, when the heliport would have to handle 1½ million passengers a year (para. 35).

20. These estimates may not conform to either of the two extreme hypotheses set out in our terms of reference but in our opinion represent a reasonable basis for planning the area required for the first permanent heliport (para. 37).

Heliport Area - Part II

21. In order to provide enough space for helicopters to land and take-off (para. 38) and for working stands (for loading, unloading, minor maintenance etc.) at the heliport (para. 39) a level area of about 8 acres would be required to handle 25 movements an hour (para. 40). In addition, an area of about 4 acres would be needed for terminal buildings and car parks, which, if the landing area were on a raised platform, could be provided on a lower deck or at ground level (para. 41).

22. For air traffic control reasons the capacity of a heliport could not be increased much beyond 25 movements an hour even by providing an additional landing area, which would involve a disproportionate amount of extra space. (para. 42).

Heliport Location - Part III

23. The heliport should satisfy the following requirements:-

(a) Since the helicopter's appeal depends on saving time, the heliport should be brought as close as possible to the main source and destination of a substantial proportion of the traffic (para. 44). More specifically it should not be much more than a quarter of an hour from Grosvenor Square, and ideally, between the West End and the City (para. 47). Because of the helicopter's potentialities for freight and mail, nearness to one of the sorting offices of the GPO would also be an advantage (para. 48).

(b) It should be conveniently placed for all forms of surface transport, good road connexions and local traffic access being especially important in view of the high proportion of passengers who will travel to the heliport in private cars and taxicabs (para. 49).

(c) It should have sufficient unobstructed approaches to enable operations to continue safely in all weathers, allowing for a climb and descent gradient not much steeper than 1 in 4 (para. 50). This may entail some restriction on building heights in the neighbourhood of the site (para. 51).

(d) To be usable at all by single-engined helicopters it should be beside the river (para. 53).

(e) In order to avoid conflict between helicopter and fixed-wing traffic to and from London Airport it should not be located further west than Battersea Park (para. 54). For air traffic control reasons it is unlikely that two sites on the Thames within easy reach of the West End could be simultaneously used to capacity (para. 55).

(f) It should be compatible with the proposals of the County of London Development Plan. (paras. 56-60).

(g) It follows from (f) that it should be so placed as to avoid interference with the normal life and work of the neighbourhood.

24. Amenity Considerations

(a) Noise Nuisance

Measurements of the noise of the various types of helicopters indicate that noise in level flight at 1,000 ft. would be no greater than traffic noises in a busy street, but since it will be more widespread routes should be chosen which as far as possible reduce flights over areas particularly sensitive to noise. The greatest noise will be in the immediate locality of the heliport and within a radius of half a mile of it under the take-off and landing paths (para. 63).

Provided the site is carefully chosen, i.e. on the river and in an area where the activities are mainly industrial and commercial (para. 65), the quieter types of turbine driven helicopter, as well as existing piston-engined types, should be able to use it at moderate frequencies without causing a serious problem. Whether the same would apply to high frequency or night operations remains to be seen (para.66).

A continued effort will be needed to clarify the effects of helicopter noise and means of abating it (para. 68). Research into noise abatement at source is being carried out by Government Establishments and manufacturers (para. 69). Meanwhile proposals for heliport development must be put in hand on the basis that noise can and will be brought down to reasonable levels (para. 70).

(b) Interference with Television and VHF

Tests carried out in open country and over London suggest that interference is unlikely to be serious (para. 71).

25. Possible Sites - Part IV

After a preliminary survey, nine sites near the river within reasonable range of the West End have been examined in some detail:-

(1) Battersea Wharf
(2) Grosvenor Road, Westminster
(3) Nine Elms (Site A)
(4) Nine Elms (Site B)
(5) Waterloo Station
(6) Charing Cross Station
(7) Blackfriars Station
(8) Cannon Street Station
(9) St. Katharine Docks

Measurements of the heights of buildings show that at each of these sites the landing area would have to be located on a raised platform to enable it to be used safely and in all weathers (para. 74). A fuller survey of heights will have to be made before safeguarding maps of the approaches can be drawn up (para. 76).

26. Short List

Although all the sites have drawbacks, the following locations are considered the most promising:-

(a) Nine Elms B (para. 80)
(b) Cannon Street Station (para. 84)
(c) St. Katharine Docks (para. 85)

Details of these three sites are given in paragraphs 86-93, in Appendix G and on plans V, IX and X.

27. No attempt has been made to assess precisely the cost since this is a matter for the promoters, whoever they may be, and it would have been necessary to appoint consulting engineers, which, in any event, could hardly be justified until the short list has been approved and decisions taken regarding responsibility for the promotion of the heliport (para. 91). But the capital cost is likely to run into several millions, although it may vary considerably between one site and another (paras. 92-93).

28. One or more Heliports

A single heliport of 12 acres should be capable of handling the traffic well into the 1970's, but will not be able to handle all the traffic indefinitely if the helicopter becomes accepted as a means of mass travel. The question of a second heliport must be left for a decision until nearer the time when the requirement is seen to emerge (para. 97).

Next Steps

29. Pending the clarification of a number of factors including the airlines' plans and the types of helicopter to be used on inter-city services, we are unable to reach a final conclusion on which site should be chosen (para. 99).

30. Meanwhile, if the short list is approved, the possibilities of reserving sites and safeguarding approaches against development that may conflict with the heliport should be explored with the Ministry of Housing and Local Government and other interested parties (para. 100).

Further studies should be put in train to investigate the effects of noise near a heliport and suitable means of mitigating it, and to establish detailed design requirements (para. 102).

31. Fresh impetus is likely to be given to helicopter development in the next year or so by the introduction of the first multi-engined types. The Westland Heliport cannot be expected to cater for the full requirement we have envisaged after 1965, and, if a permanent heliport is to be built by then, the necessary detailed planning will have to be put in hand next year (paras. 103-108).

PART I - TRAFFIC PROSPECTS AND ASSUMPTIONS

32. Our terms of reference required us to plan on two extreme hypotheses -

A. that fares could be offered low enough to bring helicopter services within the reach of the many;

B. that the fares would be so high as to exclude all but the few who could afford to buy time.

We were not asked to form an opinion on which of these hypotheses would eventually prove right. Nevertheless, we have felt bound to take a view, however speculative, of what may be possible within a reasonable time scale, and in this we have been helped by BEA's preliminary thinking about future helicopter services from central London.

Scheduled Services

33. By the end of July, 1959, when we started work, BEA had concluded that with an aircraft comparable with the developed Rotodyne it would be possible to offer regular services between central London and the centres of Paris, Amsterdam and Brussels at fares near or even slightly below the first class fares for fixed-wing services on these routes. They envisaged a gradual build-up of traffic from small beginnings using an interim helicopter carrying up to 25 passengers supplemented, and later superseded, by a larger helicopter carrying up to 60 passengers. At a later stage, services might be introduced between London and provincial cities if fares could be reduced to competitive levels, and a triangular service between the centre of London, London Airport and Gatwick might also be practicable. They envisaged that well before 1975 these services could be carrying most of the first class traffic and a fair proportion of the tourist class that would otherwise use fixed-wing services, and that some new traffic would also be created. But they did not believe that the helicopter could by that time, if ever, entirely supersede the fixed-wing services on these routes. They provided us with rough estimates of how on this basis the traffic might grow, assuming reciprocal services by foreign operators. We have also made allowance for scheduled services by other British operators.

Executive and Charter Services

34. A substantial build-up of executive movements and charter movements of freight, mail, express goods etc. also seems likely. The Westland Heliport alone handled nearly 2,000 movements in its first year of operation, averaging about 40 movements a week with peaks of 116 a week and 30 in one day, and we were impressed by the confidence of some of those who gave us the benefit of their views in the possibilities of development of this type of operation. The growth of non-scheduled and charter traffic is difficult to predict but we have made a substantial allowance to cover it.

Total Traffic

35. If our assumptions are valid, it thus seems likely that after a few years, during which the majority of movements in and out of central London may be with single-engined helicopters operating on charter and executive flights etc., the scheduled traffic will gradually predominate. The following table shows the estimates reached, together with calculations of peak and busy hour helicopter movements.

	Standard Busy Rate[1]			Absolute Peak[2] Hour Rate	
	Scheduled[3] Services	Non-Scheduled, Miscellaneous & 'Safety Margin'	All[4] Operations	All Operations	Annual Passengers (Scheduled Services)
1965	2	4-6	5-7	7-9	40,000
1967	5	5-8	9-12	11-15	200,000
1970	10	7-11	15-19	18-23	900,000
1975	15	9-14	20-25	25-30	1,500,000

1. The Standard Busy Rate is the hourly rate of movements, equalled or exceeded 30 times a year.

2. The Absolute Peak Hour Rate is the highest hourly rate recorded in the year.

3. Though essentially passenger services, these movements as a whole would meet a considerable demand for post office and freight traffic.

4. The Standard Busy Rate for all operations is less than the sum of the separate Standard Busy Rates for each group, because the highest rates for each group do not necessarily occur together.

36. While admittedly a matter of conjecture, we consider that a traffic build-up of this order goes as far towards realisation of hypothesis A as may reasonably be postulated in the period up to 1975, and it is on this basis that we have formulated our estimates of the area required for the first heliport. In any case, as will appear from later sections of the report, it seems unlikely that a heliport could safely and economically accommodate more than 25 movements an hour, and when this volume of traffic is exceeded the best way of catering for it will be to provide a second heliport rather than to expand the first.

37. We have concluded that no useful purpose would be served by preparing an alternative estimate and an alternative plan to match the more modest requirement envisaged in hypothesis B. Planning on such a scale would leave no room for the expansion which it is reasonable to expect once helicopter services establish themselves, and, at this stage, we have thought it best to concentrate on planning for the larger of the two possibilities.

PART II - GROUND AREA REQUIREMENTS

The Pad

38. The amount of land needed for the heliport will depend on the size and operational characteristics of the helicopters using it, the volume of traffic and the way in which the heliport is itself designed, due account being taken of the shape of the site available. The first need is for a pad, i.e. an area where helicopters can land or take off. An area of 400 ft. by 200 ft. for each usable direction for landing and take-off will on present information be required by multi-engined aircraft.

The Apron

39. The next need is for an apron, i.e. an area where aircraft will stand while loading and unloading. This area should be sufficiently far from the pad to avoid interference through rotor downwash, on the assumption that blast screens will be installed if needed. It must include taxiways along which helicopters can move freely to and from the pad, paths for passengers and vehicles to move between the stands and the terminal buildings, and space for apron service vehicles and others to stand on. The individual stands should be large enough to take the largest helicopters likely to be in use for as far ahead as we can reasonably see. We have assumed that these will be no larger than the developed Fairey Rotodyne with Tyne engines and the Bristol 194 (Appendix C).[*] The number of stands needed will depend partly on the length of time taken to prepare the helicopter for its next flight and partly on the number of aircraft movements at peak hours. We have also assumed that helicopters will not be allowed to stay at the heliport for a long time for aircraft maintenance or if there is a great demand for a limited space. The total apron space required, including the area set aside for apron service and similar vehicles, will vary from about 2 acres for 5 movements an hour to about 6 acres for 25 movements an hour.

Total Operational Area

40. We have examined the possibility of reducing the apron requirement by means of lifts, as on an aircraft carrier, and by the use of the river for parking, but both courses raise difficulties to which we could see no practicable solutions. The minimum operational area needed for the heliport will therefore be the sum of the figures for landing pad and apron space, viz. about 4 acres for 5 movements an hour or about 8 acres for 25 movements an hour.

Terminal and Car Parking Areas

41. Space must be found for terminal buildings and offices for heliport and airline officials. In addition, it is an essential planning requirement that the heliport, like any other large new development in London, should provide enough car parking space for the road traffic that it generates. These two requirements, taken together, mean the provision of about 1 acre for 5 movements an hour or about 4 acres for 25 movements an hour. If the pad and apron were on a raised platform, some or all of the space needed for buildings and car parks might be found under the platform, as long as the platform could be built high enough.

Total Heliport Area

42. The addition of a second pad analogous to a parallel runway would enable the heliport to handle more than 25 helicopter movements an hour, but air

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[*] On present indications, a heliport designed to handle helicopters of this size would be able, if necessary, to cater for the jet lift types of VTOL with moderate jet velocities without serious modification, apart possibly from any measures required to deal with heat.

traffic control considerations severely limit the possible increase unless the pads are separated by a safe distance, which would make the heliport very large. On the basis of the traffic estimates in Table I, therefore, we judge it prudent to plan for a movement rate of 25 an hour; this, as Table II shows, means a requirement of about 12 acres, which could be reduced to 8 if the heliport had a high enough platform. Detailed explanations of the estimates will be found in Appendices D and E.

TABLE II

	5 movements per hour		10 movements per hour		20 movements per hour		25 movements per hour	
	Thousands of Sq.ft.	Acres	Thousands of sq.ft.	Acres	Thousands of sq.ft.	Acres	Thousands of sq.ft.	Acres
(i) Landing area	80	2	80	2	80	2	80	2
(ii) Aprons	75 (2-3 stands)	1¾	100 (4 stands)	2¼	175 (5-6 stands)	4	250 (8 stands)	5¾
(iii) Apron services	10	¼	10	¼	20	½	20	½
(iv) Buildings	10	¼	20	½	40	1	40	1
(v) Car Parks	20	½	40	1	110	2½	150	3
Total		5		6		10		12

PART III - FACTORS AFFECTING LOCATION

43. The siting of a heliport must have regard to the needs of the traveller, the needs of safety and the needs of the general community. More specifically it should meet the following requirements, which are discussed in general terms in succeeding paragraphs as a preliminary to the examination of individual sites:-

(a) It should be as close as possible to the main source and destination of the traffic likely to use helicopters.

(b) It should be conveniently placed for all forms of surface transport, with good road connexions and local traffic access.

(c) It should have sufficient unobstructed approaches to enable helicopters to land and take-off in safety in all weathers.

(d) It should be suitable for use by single-engined helicopters.

(e) It should be so placed as to avoid conflict between the operations of helicopters and fixed-wing aircraft. If two or more heliports are ultimately needed they should be sited to allow the fullest use of each one.

(f) It should be compatible with the proposals of the Development Plan.

(g) It should be so placed as to avoid interference with the normal life and work of the neighbourhood.

Proximity to the Source and Destination of Traffic

44. Since the helicopter in its next phases will still not be a cheap means of travel, its appeal will largely lie in its ability to shorten the journey time between central London and other city centres. This means saving time on the ground, for even the improved types of helicopter now in prospect will be much slower than fixed-wing aircraft in the air. It follows from this that the success of these services will largely stand or fall on how close in terms of journey time the heliport can be brought to the travel market, i.e. the potential source and destination of the greatest number of passengers.

45. Surveys of the origins of air passengers departing from London Airport show that just over half of them either start their journeys from central London or pass through it (often stopping overnight) on their way to the airport. The majority of these passengers come from the main hotel areas in the West End, the other principal sources being the main line railway stations and the City. The 'centre of gravity' of all these sources of passenger traffic lies in the neighbourhood of Grosvenor Square.

46. Other things being equal, it might be argued that if the heliport can be so placed as to offer any saving of time compared with the time it takes between London Airport and central London the helicopter service would be more attractive than the fixed wing. However, since the helicopter will be slower in the air and the fares will be high in relation to tourist fares on fixed-wing services, the saving in time on the ground must be substantial to make the helicopter worth while. The general consensus of opinion is that the attractions of the helicopter service will fall off sharply when the journey time to or from the heliport is more than about a quarter of an hour. This is supported, not only by the views of several of our foreign witnesses, but also by experience with the Westland Heliport at Battersea, which is roughly twenty to twenty-five minutes from Grosvenor Square and is thought to be too far conveniently to serve the type of regular traffic we are envisaging.

47. The central area of London is so large and the roads subject to so much congestion at peak times that there is no point within a quarter of an hour of all the traffic generating areas at all times of day. But we did not think that we should go far wrong if we could find a location not much more than quarter of an hour or so from Grosvenor Square at peak travel times and within convenient reach of both West End and City.

48. In view of the potential traffic of parcels, freight and mail it is also desirable that the heliport should be within easy reach of the main London sorting offices of the G.P.O. or one of the district offices.

Convenience for Transport

49. It will be observed that we have taken account only of road journey times to and from the various locations and not the times by other forms of transport. This is because we consider that the normal mode of travel to the heliport will be private cars and taxicabs - a view which is borne out by experience in other countries - although proximity to public transport will be an added advantage. Good road connexions between the heliport and the potential travel market will thus be essential. In evaluating the different sites we take account of the road improvements planned for the London area within the next few years, but we do not think that these will affect the relative merits of the sites very much. Eventually, the volume of traffic generated by the heliport might call for additional improvements, but these would in most cases be confined to the vicinity of the heliport, since further afield heliport traffic would spread itself fairly thinly over the road network of central London.

Unobstructed Approaches

50. Multi-engined helicopters will probably climb and descend along gradients of approximately 1 in 4 and, under instrument flying conditions, will begin the straight-in portion of their final approach up to 2 n. miles from the heliport. However, until the approach, landing and take-off procedures have been worked out and approved, there will be a good deal of uncertainty about the eventual obstruction-free slope. For present purposes the technical desiderata we have adopted are:-

(i) for instrument conditions, an obstruction-free slope of 1 in 10 from the pad, and for visual conditions a corresponding slope of 1 in 8: to take account of the possibility of one engine failing on take-off, these slopes would become flatter after reaching a height of about 300 ft;

(ii) to allow for the possibility of helicopters overshooting, each approach direction should be supplemented by a corresponding obstruction-free sector on the opposite side of the pad; and

(iii) at least one approach and one take-off funnel should be aligned reasonably close to the prevailing west-south-westerly wind, and a sufficient number of approach and take-off sectors should be available to enable operations to continue in all wind conditions.

51. Figure I illustrates the relationship between the obstruction-free gradients and the helicopter's climb and descent path for a typical city centre heliport. It will be seen that some restriction on building heights may be called for near the site.

52. The use of any particular funnel will depend upon the ability of the helicopter to approach or take off under varying wind conditions: for the purposes of comparing the operational advantages of individual sites, we have assumed that helicopters will be able to approach and take off safely and accurately with a 15-knot cross-wind component. Since the success of the helicopter depends upon services being operated with very high

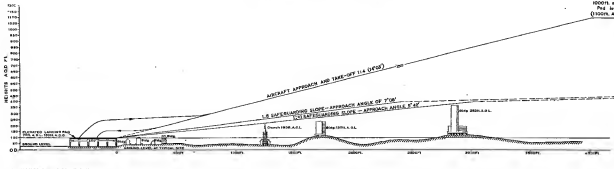
TYPICAL LONDON HELIPORT

FIG. 1.

PROFILES OF AIRCRAFT APPROACH AND TAKE-OFF SLOPES AT 40KNOTS AIR SPEED IN ZERO WIND AND 1:10 AND 1:8 OBSTRUCTION FREE SLOPES

SCALE 1:2500

NOTE:- It is expected that under instrument conditions aircraft will approach at angles between 13° and 20°


1000ft. above
Pad level
(1100ft. A.O.D.)
AIRCRAFT APPROACH AND TAKE-OFF 1:4 (14°03')
1.8 SAFEGUARDING SLOPE—APPROACH ANGLE OF 7°08'
1:10 SAFEGUARDING SLOPE — APPROACH ANGLE 5°42'
Bldg 250ft. A.G.L.
Church 180ft. A.G.L.
Bldg 120ft. A.G.L.
ELEVATED LANDING PAD
70ft. A.G.L. 100ft. A.O.D.
400'
Bldg
Bldg
Bldg
Bldg
GROUND LEVEL
GROUND LEVEL AT TYPICAL SITE
HEIGHTS AOD Ft
1200
1150
1100
1050
1000
950
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
OD
0
500Ft.
1000Ft.
1500Ft.
2000Ft.
2500Ft
3000Ft
3500Ft.
4000Ft.

M.O.A. C.N.O12 D.D. Drg No. 2890 17-8-50 regularity, on these criteria a heliport should have sufficient obstruction-free approaches available for it to be used on nearly all occasions, and certainly not less than 95% of the time.

Use by Single-engined Helicopters

53. Our estimates of traffic prospects make allowances for a high proportion of charter operations, for many of which single-engined helicopters will still be used. In the interests of safety of persons and property on the ground, single-engined helicopters are in practice required under the Air Navigation Order 1960 to follow the course of the river while flying over central London. In order to serve the needs of these helicopters, the first heliport must be located on or near the river.

Air Traffic Control

54. An important consideration in the siting of a heliport is the need to avoid conflict between helicopters operating into the central area and fixed-wing aircraft landing and taking off from London Airport. Since one of the main approaches to the airport passes over London, air traffic control considerations would put an effective ceiling of 1,000 ft. on helicopter operations over much of the central area. This height rises progressively further to the east as the heights of fixed-wing aircraft increase with their distance from the airport. It would therefore be advisable to site a major heliport intended for instrument operations east of Battersea Park to avoid interference with fixed-wing traffic.

55. If two heliports were needed, in order to avoid conflict between operations into them they would have to be sited at least 3 n. miles apart. The distance required between them could be as great as 7 n. miles if the main landing and take-off paths into each coincided with the line joining them. It follows that the site for a second heliport which would allow both to function to their fullest extent can be decided only when the site for the first has been chosen. As the river Thames runs through London from west to east, which corresponds roughly to the prevailing wind direction, it is unlikely that two major heliports could be found beside the river in central London which could operate simultaneously to their full capacity, unless a high proportion of cross-wind approaches were acceptable.

Compatibility with the Development Plan

56. For convenience we define the central area as the area bounded by the ring of the main line termini, i.e., Paddington, King's Cross, Liverpool Street, Waterloo and Victoria Stations. Within this intensively developed area of 8½ square miles there is a residential population of ¼ million and a daytime population of 1¼ million, of whom 620,000 are office workers. This area also includes many of London's foremost teaching hospitals and accommodation for 50,000 people in hotels. The preservation of its amenities and the maintenance of its activities are essential to the life and character of the area.

57. The Town and Country Planning Act, 1947, requires the Local Planning Authority to survey its area and prepare a development plan, which has to be revised periodically. The development plan defines the sites of proposed roads, public buildings, aerodromes, parks and other open spaces and also allocates areas of land for residential, industrial and other purposes. The first County of London Plan was approved by the Minister of Housing and Local Government in 1955 and the revision of this Plan is now before him. No area has been defined as a heliport in the revised plan but provision could be made as an amendment or by the consideration of a town planning application.

58. The planning authority also considers the design of buildings and their effect on amenities. It also determines the suitability of the development with regard to access to the site and car parking facilities.

59. Although a large public park, such as Battersea or Hyde Park, might be thought the obvious first choice for a heliport, this would be incompatible with the use of "open space" as envisaged in the Development Plan. Furthermore, there is a considerable shortage of public "open space" in London and its sacrifice for another purpose would be contrary to the policy of increasing public open space until a reasonable minimum target has been achieved.

60. These factors place severe restrictions on the possibilities of finding a suitable site in the right place from the point of view of the traveller, i.e. in the central area of London. Like other considerations, they tend to direct the search to the banks of the Thames near dock areas, in or near railway activity, or in areas zoned for commerce, warehouses or industry.

Amenity Considerations

Reduction of Noise Nuisance

61. A heliport is bound to generate some noise and this will be one of the main factors affecting the choice of site; indeed there are some possible sites in London which will be ruled out because of it. At the same time the effect on local amenities has to be weighed against the service given to the community at large by this new type of modern, convenient transport.

62. We have examined this problem in considerable detail. Shortly after our appointment we set up the working group mentioned in paragraph 3 with a remit to assemble all available data on the subject of helicopter noise and to give the Committee such indications as it could as to how far noise would be a critical factor. The working group, in collaboration with the aircraft manufacturers and others, collected a considerable amount of data about noise and reported to the full Committee in January 1960. The results of their work, together with data collected from subsequent field work, are summarised in Appendix F, which provides a comparison of the noise of various types of helicopter with noises commonly heard in London and with various standard criteria of noise interference; it illustrates in a necessarily abstract form the spread and duration of noise around a heliport.

63. The general conclusions to be drawn from these studies are as follows:-

(i) In cruising flight at altitudes of about 1,000 ft. the noise level on the ground of the different types of helicopter should not be greater than that of traffic in a busy street at pavement level, but the noise would be heard over a wider area. Therefore, even though helicopters should be able to fly at or above 1,000 ft. over most of London, routes should be chosen which, as far as safety and navigational requirements allow, reduce flights over specially noise sensitive areas on the ground.

(ii) The greatest noise will be heard in the immediate vicinity of the heliport* and beneath the approach and take-off paths within half a mile of the pad. During landing and take-off, multi-engined helicopters with shaft-driving gas turbine engines will make either less or about the same noise as the much smaller piston-engined helicopters used at present. But present prototype tip-jet helicopters are very much noisier while landing and taking off.

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*Since minor maintenance alone will be carried out at the heliport and consequently prolonged engine-running at high power will occur only in exceptional circumstances, most of the noise around the heliport will be created by helicopters actually landing and taking-off.

64. A suggestion which seems to have some public support is that the noise caused at a heliport could be rendered innocuous by building the heliport on a sufficiently high platform, but to reduce the noise significantly by height alone would be impracticable for a number of reasons, not least because the regularity of operations would suffer when there was low cloud and because the cost would be extreme.

65. We have already drawn attention to the other advantages of a site on the river. Such a position would also help to reduce the noise problem, for the river provides a clear area of 800-1,000 ft. separating the source of noise from buildings on the opposite bank. If, in addition, the heliport is on one of the stretches of the river beside railway yards, warehouses, docks, etc., where the residential and office population is usually small and where there is already a high level of background noise, the effects of helicopter noise will be less serious. A heliport on the river and beside an industrial area of this kind would also have at least one potential approach and take-off path largely clear of offices and dwellings, and, provided these paths can be used on the great majority of occasions, the heliport will be able to operate safely and efficiently while causing the least disturbance.

66. If the heliport is so sited, the quietest types of multi-engined helicopters, such as the Bristol 192 and the Vertol 107, as well as the current versions of piston-engined helicopters, should be able to use it at moderate frequencies without causing a serious problem. We cannot yet say that the same would apply to services operated with a high frequency or during night hours over residential areas.

67. It could be expected that, within the bounds of safety, operating techniques could be adjusted to reduce the noise falling on particular areas around the heliport, e.g. steeper take-offs and landings would help to contain the spread of high noise levels while intensifying the effect in the immediate vicinity, where it will matter least. Appropriate techniques will have to be worked out for the chosen site.

68. Nevertheless, however much ingenuity is exercised in siting the heliport so as to mitigate noise, the problem is not by any means fully resolved. We do not yet know enough about the effects on the community and of screening by high buildings in the vicinity of sites, and a further detailed study of these matters is required before the construction of a major heliport is put in hand.

69. We also consider that a continued effort will be needed to find means of abating the noise at source and we are glad to hear research into this is being carried out by manufacturers and by Government Establishments, especially into the noise from tip jets.

70. Meanwhile, we put forward our proposals on the basis that helicopter noise can be brought within reasonable limits by means of a combination of careful siting, operating techniques and further progress in noise abatement at source.

Interference with Television and V.H.F. Reception

71. A series of tests has been carried out, both in open country and over London, by the General Post Office, in collaboration with the Ministry of Aviation, BEA and the broadcasting and television interests, to establish the degree of interference likely to be caused to television and V.H.F. reception by helicopter operations. The indications are that such interference will not be serious.

PART IV - POSSIBLE SITES

72. From the preceding discussion in Parts II and III, it emerges that the ideal site in London should be able to provide an ultimate area of 12 acres on one or more levels, and should be

(a) within about quarter of an hour by road of the West End, but also within easy reach of the City,

(b) well served by public transport,

(c) in an area sufficiently free of high obstructions to allow the heliport to be used safely on all occasions,

(d) on or near the river Thames,

(e) east of Battersea Park,

(f) in a neighbourhood where there would be the least interference with normal life and work, and

(g) in or near areas zoned for industry or commerce, or where there is a high level of background noise, and where a large percentage of take-offs and landings could be made over the river or areas not normally sensitive to noise.

Sites Considered

73. Since the closing of the South Bank site and up to the date of our appointment, the Ministry of Transport and Civil Aviation had considered 49 sites including some suggested by Members of Parliament, the London County Council and other local authorities and private individuals. These were all re-examined with an eye to the new requirements and were found in their original form to be either too small or too far from the river. Some locations, however, were promising and have been taken into account by the London County Council, who undertook the search for suitable sites.

74. There are very few sites in London where a heliport sufficiently large to cater for 25 movements an hour by large helicopters could be built. To clear substantial acreages of existing buildings for a heliport at ground level would be extremely costly and would represent an uneconomic use of very valuable land. Moreover, in the vicinity of virtually any site near central London there are high buildings which eliminate wide arcs for use as obstruction-free approach and take-off funnels if the heliport is at ground level. These considerations taken together have forced us to the conclusion that the heliport will have to be built on a raised platform, with ancillary facilities housed beneath the flight deck and any remaining space devoted to the zoned activity of the neighbourhood.

75. Subject to the need to keep below low cloud for take-off or touch-down, the number of obstruction-free flight sectors to and from a site would, in most cases, be progressively increased the higher the heliport was built. But it is also generally true that the higher the platform the more expensive it will be to build. With this in mind we have chosen the lowest platform height needed to give a site an acceptable standard of operational efficiency. Sometimes, however, the height of the platform will be affected by other considerations, for example, planning limitations and the necessity to allow unhampered use of the area beneath.

76. Plan I illustrates the 9 possible sites that emerged from our survey. Detailed assessments are given in Appendix G, and their main features are described below. In studying the operational characteristics of the various sites we have made a number of measurements of the heights of buildings in their vicinity, but a fuller survey will have to be made in due course before detailed safeguarding maps can be prepared for a

particular site.

Battersea Wharf (Plan II)

77. This is a site of roughly 8 acres fronting the river on the south bank and extending southwards between Queenstown Road and the main line railway into Victoria Station. In order to overcome the obstruction of the towers of Chelsea Bridge, the heliport would have to be on a platform 80 ft.* high, and would have to be extended over the river to provide adequate pads and to avoid building over road or railway. There would then be more than enough space on the platform or beneath it for a full 12-acre heliport, although the shape of the site would hamper movement between the pads and apron. The site is close to the West End by car, but badly served by public transport. There are comparatively few people living and working in the vicinity, and the majority of take-offs to a height of 1,000 ft. would be over Battersea Park or the river. However, if helicopters were to avoid approaching to land over the residential areas of Pimlico by flying over the river, the high chimneys of Battersea Power Station would rule out operation on too large a number of occasions for the site to be acceptable for regular services.

Grosvenor Road, Westminster (Plan III)

78. The site lies on the north bank of the Thames immediately opposite Battersea Wharf. Much of the site is in constant use as a Refuse Disposal Depot and Works Department and a Main Drainage Pumping Station. If some residential and office property were demolished, a 10-acre heliport platform could be built 60 ft. high, but, owing to the need to allow present activity to continue, little space would be available below the platform to house the necessary terminal facilities. The West End is within easy reach by car, but public transport connections are poor. Apart from the south and south-west, the site is surrounded by densely populated areas. Although most take-offs up to 1,000 ft. would pass over Battersea Park, the only landing direction available clear of residential areas has a very low standard of usability. The platform would interfere with the daylight on adjoining property, and work and demolition would cause serious disturbance.

Nine Elms (Plans IV and V)

79. Site A lies about 600 yards upstream from Vauxhall Bridge and covers an area of about 9 acres extending southwards from the river bank. A platform at least 20 ft. high would be required to provide space for terminal facilities and to allow headroom for vehicles passing along Nine Elms Lane, which divides the site in two. The shape of the site does not lend itself to an economic distribution of parking space or to free movement between pad and apron. The site has no direct over-shoot paths to supplement its three approach sectors and because of nearby obstructions its operational features could be improved only by raising the platform a great deal higher. The area immediately south of the site is industrial, but there are large blocks of flats directly opposite the site on the north bank. Although the majority of take-offs and approaches could be made over the river, helicopters would pass close to the north bank at quite low altitude.

80. Site B is some 200 yards east of site A, and could provide a 13-acre platform over the North Goods Depot, spanning Nine Elms Lane, and over an area beside the river. To allow the goods depot to continue in full use the platform would have to be 50 ft. high. This would seriously affect adjoining properties east and west of the site. Although the goods depot would take up much of the space below the flight deck, sufficient space for terminal facilities would be available

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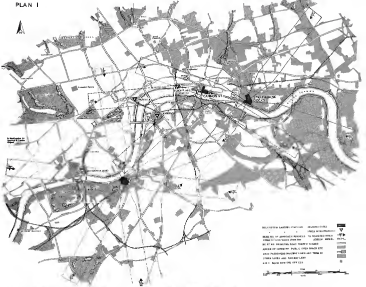
*The platform heights quoted are above ground level.

PLAN I



N
BLACKFRIARS STATION
CANNON ST
ST KATHARINE DOCKS
WATERLOO
HELICOPTER LANDING STATIONS SELECTED SITES
OTHER SITES PROPOSED
BEARINGS OF APPROACH FUNNELS TO SELECTED SITES
BE AT NO PRINCIPAL ROAD TRAFFIC ROUTES
AREAS OF INDUSTRY PUBLIC OPEN SPACE ETC
MAIN PASSENGER RAILWAY LINES AND TERMINI
OTHER LINES AND RAILWAY LAND
G P O MAIN SORTING OFFICES
Miles
Yards

on the site. The site has a wide range of unobstructed approach and take-off sectors. The pads most in use would be set back from the river and the main impact of noise would fall on industrial and railway activity, and less on the residential areas on the north bank. Landings and take-offs could be confined to paths over industrial areas or the river without much reducing the very high usability of the site.

Waterloo Station (Plan VI)

81. The station roof offers an area of about 11 acres. A platform would have to be at least 73 ft. above the level of the station concourse if railway activity was not to be interfered with. The practical difficulties of building a suitable platform are extreme and even then there would be a shortage of space to house terminal facilities. Although the site has excellent access to the West End by road and public transport, for safety reasons it could not be used by single-engined helicopters. The surrounding area contains two large hospitals, a number of large offices, residential areas and the Festival Hall, and multi-engined helicopters could not avoid passing over these while at low heights.

Charing Cross Station (Plan VII)

82. A platform over the roof of the station would have to be extended over the northern end of Hungerford Bridge if adequate pads and approach sectors were to be provided: the area available would then be 7 acres. To avoid interference with the running of the station, the height of the platform would have to be at least 65 ft. As at Waterloo, construction would be difficult and there would be a shortage of space for terminal facilities. Although the site is very well placed for access to the West End and City by road and public transport, the neighbourhood contains large offices, hospitals, theatres and hotels, which would be particularly sensitive to noise. All landings and take-offs, though passing over the river, would pass near such buildings while helicopters were at low heights. The heliport structure would interfere with daylight on the Victoria Embankment Gardens, and objections could be expected from some quarters to the appearance of such a prominent structure on the north bank.

Blackfriars Station (Plan VIII)

83. A heliport platform of about 6 acres could be built immediately east of the station. The platform would have to be at least 25 ft. above the level of Queen Victoria Street to allow clearance for vehicles. The size of the site would be defined by the road layout consequent on the City Corporation's improvement of the northern bridgehead of Blackfriars Bridge. The small platform area would limit the number of movements that could be handled by the heliport. But there would be ample space to house the necessary terminal facilities. The site is well placed to serve both West End and City, but access for road vehicles would be awkward. A great many people work near the site during the day, and St.Paul's Cathedral is close at hand. If take-offs and landings were confined to the two flight sectors that pass over the river and industrial areas, the regularity of operations would be inadequate for scheduled services.

Cannon Street Station (Plan IX)

84. The available area of the station roof would be about 3 acres, which by itself could cater for isolated movements by single and by small multi-engined helicopters, but would be inadequate for regular and frequent services. The addition of a platform extending 200-250 ft. along the eastern side of the station would provide a flight deck of about 5½ acres in all at a height of 54 ft. This could later be expanded further east beside the river to give a total of 7 acres for pads and apron. More than enough space could be provided for passenger handling, car parks, etc. even at the smaller site. The site is within reasonable reach of the West End. North of the site is an area of high density office

development, but in contrast, the area to the south is almost entirely composed of riverside or industrial activity. All the site's approach and take-off sectors pass over the river or the industrial area on the south bank and clear of the office areas of the City, so that the operational usability of the site would be high while causing the least disturbance.

St.Katharine Docks (Plan X)

85. To overcome the main obstructions of cranes, warehouses and the towers of Tower Bridge, a heliport platform would have to be at least 48 ft. high. Even then a number of cranes would have to be reduced in height to give the site satisfactory approaches over the river. By demolishing two blocks of flats and incorporating the existing warehouse activity below the heliport structure, a platform could be built over a ground area of about 9 acres. More than enough space would be available for terminal facilities beneath the flight deck, and the remainder could be used for warehousing. Traffic from the West End would have to travel a considerable distance and go through the narrow and frequently congested streets of the City to reach the site. The activity in the neighbourhood is mainly warehousing, but some residential areas and the precincts of the Tower of London are nearby. With the majority of approaches and take-offs confined to the river and industrial areas the site would still have a high standard of usability for multi-engined helicopters.

Short List

86. Of the nine sites, operational, amenity and other considerations weigh heavily against six: those at Battersea Wharf, Grosvenor Road, Nine Elms (A) and Waterloo, Charing Cross and Blackfriars Stations. Our selection has been made purely on the basis of planning requirements and does not imply that the landowners, including the British Transport Commission and the Port of London Authority, are committed to approving of the sites for development as heliports, and formal consultations with them will be required. The main features of the remaining three sites are compared in Table III.

Operational and Access Features

87. The Nine Elms (B), Cannon Street Station and St.Katharine Docks sites would have good operational characteristics even if flights were confined for the most part to areas where noise will be less of a nuisance. The size and shape of the landing area in each case could allow the full 25 movements an hour through a single pad, and ample space would be available on the site to house terminal facilities. Nine Elms (B) and Cannon Street Station are reasonably well placed to serve the West End and City traffic, but St.Katharine Docks is rather too far from the West End to be within convenient reach for the majority of travellers.

Noise Features

88. In the absence of more detailed knowledge of local conditions and the noise at source of the helicopters now under development, it is difficult to judge which is the best site with respect to noise. The problem will take a different form at each site. Cannon Street Station has flight sectors which pass almost exclusively over the river or industrial areas during the phase when helicopters would be at heights below 1,000 ft., and the critical period would be when helicopters were just above the pad on take-off and landing. This being the case, the effect of shielding by buildings close to the site could be an important factor. Although the working population north of the site is very great, the number of residents is small so that few people would be affected out of working hours. The site at Nine Elms, on the other hand, is surrounded to the south by a belt of industrial and railway installations and on the north by the river, which between them create a zone at least 1,000 ft.

TABLE III

SITE	SIZE (ACRES)		PLATFORM HEIGHT above ground	USABILITY of approaches over river or industrial areas	NOISE FEATURES		ROAD TRAVEL TIME (MINUTES)[x]		PUBLIC TRANSPORT
	Platform	Floor Area below platform			Development within 1/4 mile	"Clear" distance along flight sectors[ø]	Grosvenor Square	Mansion House	
NINE ELMS(S)	13 (Pads + up to 9 working stands)	16	50 ft.	99%	Population:- 2,500 residents Sensitive buildings 4 proposed schools	Take-offs 2,000-3,000 ft Landings:- 2,500-3,000 ft.	15-19	17-19	No underground station close to the site, but the Victoria Tube Extension might be pushed southwards to provide a station at Vauxhall.
CANNON STREET STATION	(i) 5½ (Pads + 4 working stands) (ii) 7 (Pads + 7 working stands)	9 12	54 ft.	98%	Population:-330 residents:45,000 office workers Sensitive buildings Mansion House, Southwark Cathedral	Take-offs:- 4,000 ft. Landings:- 4,000 ft.	23-27	1-2	Cannon Street Underground Station and frequent buses along Cannon Street.
ST.KATHARINE DOCKS	8½ (Pads + 9 working stands)	21	48 ft	98%	Population:- 400 residents Sensitive Buildings:- The Tower, The Royal Mint and a school.	Take-offs:- 1,000-4,000 ft. Landings 4,000 ft.	28-34	10-13	Tower Hill Underground Station 10 minutes walk away

[x] The present average journey time by car according to the time of day.

[ø] Areas of predominantly commercial or industrial development.

in radius where noise will not matter much, and the main problem would be encountered some way from the site beneath the flight sectors, for which suitable operating techniques would have to be worked out. At St. Katharine Docks, the immediate area is devoted mainly to warehousing or dock activity, and the flight paths, except on take-offs in the direction of the Tower, would be over industrial areas. Care would have to be taken to reduce the noise falling on the residential areas north-east of the site.

Development Features

89. In contrast to the sites at Nine Elms and St.Katharine Docks, both of which lie in public ownership, reserving the site at Cannon Street Station would be complicated by the number of different interests owning the land and by the urgency imposed by the scheme to redevelop the station, on which the British Transport Commission and others have already made much progress. A number of planning applications for areas enclosed by the site are demanding early attention and the City Corporation have received permission to build on part of the site a multi-storey car park, the design of which would have to be modified to allow for the eventual heliport platform over it.

90. The City Corporation and the Port of London Authority have been informed that sites at Cannon Street Station and St.Katharine Docks are being considered as possible heliports. The City Corporation have expressed an informal preference for a site east of the Tower rather than at Cannon Street, and the Port of London Authority consider that a heliport in St.Katharine Docks would interfere with their plans for the future use of the area. The British Transport Commission have no objection in principle to the use of the site in Nine Elms provided the activity of the goods depot is allowed to continue. These interests and the Metropolitan Boroughs concerned should be formally consulted.

Economic Features

91. We have not interpreted our terms of reference as requiring us to carry out a comparative study of the economics of the different sites, for this seems to be a matter for the promoters, whoever they may be, and for the airlines. Moreover, fairly detailed studies by consultant engineers would have been necessary, and their appointment could scarcely have been justified until the most promising sites had been established and a short list approved.

92. At the same time, we have not underestimated the importance of cost in heliport planning since it will ultimately govern the scale of landing charges and could have a considerable effect on the fare structure of helicopter services. From such rough estimates as have come our way in the course of our planning study, it seems that the capital cost may well be of the order of several millions of pounds. The consultants preparing the Cannon Street Station redevelopment have estimated that to build a heliport platform of about 3 acres alongside the station on the east would cost about £4.5 a sq.ft.: a further £350,000 would be needed to strengthen the 3-acre station roof up to heliport standards.

93. Besides the cost of construction, land values, safeguarding costs and the return from leasing any extra space beneath the flight deck will all play a part in the final analysis. The position is complicated by the special problems of construction and safeguarding at individual sites.

One or More Heliports

94. For planning purposes, we have considered how best to meet the demand for heliport facilities as it will develop in the foreseeable future.

Our traffic estimates, summarised in Table I, indicate that the total demand is not likely to exceed 25 movements an hour before the mid-1970s. Since each of the short-listed sites could ultimately be made large enough to handle this volume of traffic, the immediate aim should be to decide which of them should be developed as the first heliport.

95. The growth of helicopter services is unlikely to reach sufficient proportions to demand that the first stage of development be completed much before 1965. The position is still far from clear, and the time-table for a permanent heliport will have to be reviewed in the light of operators' plans, but, until these take more definite shape, 1965 could be regarded as a reasonable target date for immediate planning purposes. In the meantime, the demand for a heliport in London is being met by the Westland Heliport at Battersea, which should be able to cater for the growth of charter operations over the next few years, and possibly the beginnings of scheduled operations as well.

96. When the first heliport is seen to approach saturation the question will arise whether to expand it by the addition of another operating area or to build a second separate heliport. The airlines, who will gain from concentrating their organisation at one place, may tend to favour the first course. But it seems very likely that, once a movement rate of 20-25 is reached in a peak hour, a single heliport will be working to optimum capacity and that the additional land required for a second landing area would be disproportionate to the gain in movement capacity. At that stage the answer will therefore probably be to build a second heliport.

97. The new site will have to be some distance from the first for air traffic control reasons, but its exact position will depend upon which site is chosen as the first heliport and whether the number of single-engined helicopters still in service would warrant another site by the river. Amenity considerations will still apply, but, if the principle of convenience to traffic is adopted, the second site would bring helicopter services into convenient reach of a wider area and a greater public. If the helicopter breaks into the mass travel market, more than two heliports might ultimately be needed. Any attempts to answer these questions on the basis of present knowledge could be well wide of the mark and we have deliberately refrained from going any further than suggesting sites for a first heliport.

Next Steps

Choice and Safeguarding of Sites

98. We accordingly offer the three sites as the most promising for selection of the first permanent heliport for central London.

99. We are unable at this stage to reach a firm conclusion on which of the three sites should be chosen. The answer will depend on a number of factors yet to be determined, including the plans of the airlines for the operation of helicopter services into central London, and, more specifically, the type of helicopter they propose to use. Moreover, before the final choice is made there will have to be formal approaches to the interested parties, including the British Transport Commission and the Port of London Authority, the latter having made it clear that despite their earlier interest in establishing a heliport they now regard it as incompatible with other development at St.Katharine Docks.

100. Meanwhile, we recommend that

(a) the three sites should be officially accepted in principle as possibles;

(b) pending a final choice, ways and means of avoiding development at these sites that may be incompatible with the development of a heliport should be explored with the Ministry of Housing and Local Government, the local authorities and the landowners; and

(c) the restrictions that would be required on the heights of buildings in the flight paths associated with the sites should be worked out and their financial and other implications examined. Such restrictions are already in force in the neighbourhood of aerodromes by reason of Orders under Section 26 of the Civil Aviation Act, 1949.

101. We recognise that the reserving of sites and the safeguarding of the surrounds in London present considerable difficulties, but, if a heliport is to be provided in London, it is clearly desirable that an effort should be made as soon as possible to hold the position since the number of high buildings is rapidly increasing and the areas capable of a development such as we envisage are rapidly diminishing.

102. There are also a number of other questions which call for further investigation, notably the effects of noise on activities near the heliport, and the means of mitigating it. The detailed technical and design features of a major heliport will also have to be studied.

Further Considerations

103. We have approached the problem as planners and not as promoters, but the questions of what steps are to be taken to provide a heliport and who is to promote it have inevitably intruded into our deliberations from time to time, even though it is no part of our remit to answer them.

104. It may be helpful, however, if we draw attention to a few of the considerations that have some bearing on the next steps and their timing.

105. Planning permission for the Battersea Heliport, which is now the only heliport for London, will expire in 1965. Even if the Westland Aircraft Co. are ready and able to obtain an extension, the heliport will be too small for the traffic we envisage.

106. Whereas, so far as we know, the plans of the airlines for services into central London are not as yet established, multi-engined helicopters are likely to be brought into service in Chicago, New York and Los Angeles during 1961 and this may well give new impetus to similar developments in this country and in Europe.

107. We have received evidence from a private firm that they intend to renew their application for planning permission for a heliport at Nine Elms on the basis of a larger scale scheme than that for which permission was refused on appeal by the Minister of Housing and Local Government in May 1959. The proposal they have in mind is distinct from and smaller in scale than the site B plan we have put forward as one of the most promising schemes.

108. Finally, if a heliport is to be built by 1965 or thereabouts, the necessary technical design study will have to be put in hand in the near future, for the preliminary planning, drawing up of sketch plans and letting of contracts for construction will together take not less than four years.

Acknowledgements

109. In conclusion we wish to express our appreciation to all those members of the staffs of British European Airways, the engineering and town planning departments of the London County Council, the British Transport Commission, headquarters and Southern Region, and the Ministry of Aviation, including the Aviation Operational Research Branch, the Aviation Economics and Aircraft Branch, the Directorate General of Navigational Services and the Directorate of Civil Aircraft Research and Development, who contributed the information upon which our conclusions are based. We especially wish to record our thanks to our Secretaries - Mr. Clark and Mr. Benjamin, who took over after Mr. Dunsire had returned to his post at Exeter University, and Mr. Meagher.

(Signed) G. I. Morris
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G. W. Quick Smith
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A. H. Watson
W. B. Lewis

D. C. Clark) Joint Secretaries
P. E. Meagher)
C. B. Benjamin)

October, 1960.

APPENDIX A

LIST OF PERSONS WHO GAVE EVIDENCE TO THE COMMITTEE

Administration de l'Aéronautique. Belgium	Mr. P. Nottet
Aéroport de Paris	Mr. J. Vasseur Mr. Prinz
Municipalité de Bruxelles	Mr. A. de Gryse
Cologne Town Council	Director Ortmann Director Steimel
Cologne - Bonn Airport Authority	Professor Steinmann
Fairey Aviation Ltd	Dr. G. S. Hislop Mr. D. M. Davies Mr. W. R. Gellatly Mr. K. T. McKenzie Mr. A. Stepan Mr. L. P. Twiss
Federal Aviation Agency, United States	Lt.-Col. T. Ross
Federal German Ministry of Transport	Regierungsdirektor Lippe Ministerialrat Dr. Hentschel
General Post Office (by correspondence)	
Helicopter Association of Great Britain	Lt.-Col. J. W. Richardson Mr. B. H. Arkell
London Chamber of Commerce	Mr. A. R. B. Hore Lt.-Col. J. W. Richardson
Netherlands Department of Civil Aviation	Mr. Falkenhagen Mr. Sitter Mr. Ruyer
New York Airways	Mr. G. B. Eastburn
Port of London Authority	Sir Leslie Ford,O.B.E.
Port of New York Authority	Mr. J. P. Veerling
Rotorports Ltd	Lord Morris of Kenwood Mr. H. M. Berney Mr. A. Lee Mr. R. T. Myers Mr. J. W. Pooley Mr. N. Wallis
Rotterdam Municipality	Mr. J. A. C. Tillema Mr. Van der Hoek Mr. Van der Ban
SABENA	Mr. A. V. J. Vernieuwe Mr. M. Dans Captain Blondiau Mr. Bourgois Mr. Delmotta Mr. Lambotte

/Secretariat

Secretariat Générale à l'Aviation Civile et Commerciale, France	Mr. J. Lassalle
Transport Ministry North-Rhine Westphalia	Mr. Wagner
Westland Aircraft Ltd	Mr. O. Fitzwilliams Mr. R. Hafner Mr. J. Fay Mr. J. Speechley Mr. H. B. Irving
Westland Heliport, Battersea	Lt.-Col. J.W. Richardson Mr. J. S. McHutcheon

APPENDIX B

OUTLINE OF CURRENT SCHEDULED SERVICES

Types of Helicopter

Present Helicopters

1. The development of scheduled passenger services by helicopter is restricted by the limitations of single-engined helicopters.

(a) They are expensive to operate; total operating costs for the scheduled helicopter operators in the United States during 1959 were 3/6 per seat-mile, or 7/- per passenger-mile at a load factor of 51.5 per cent. Consequently fare levels tend to be high compared to other types of transport.

(b) Their limited range and speed mean that the saving in time over other than short stages is marginal.

(c) Their inability to maintain powered flight in the event of engine failure restricts operations -

(i) to special routes over built-up areas where there is a landing area within auto-rotation reach and where there would be little risk of injury to persons or property in the event of engine failure (these routes invariably involve a detour), and

(ii) to visual conditions, with a resulting loss of schedules in inferior weather.

Multi-engined Helicopters

2. The introduction into commercial service after about 1961 of the multi-engined derivatives of present military helicopters could alter the present situation. Increased size and performance should improve the economic characteristics, and greater speeds and extended stage distances should also be possible,all of which will place the helicopter in a better position to compete with services offered by other means of transport. Such helicopters capable of satisfying the full performance requirements for maintaining flight if one engine fails and of proven mechanical and structural reliability,which are also equipped with suitable navigational aids, should be able to operate with high regularity in poor weather and at night.

Scheduled Passenger, Mail and Freight Services

3. In America these generally take the form of short stage connexions between city centres and airports, or between airports where there is very heavy "interline" traffic.

4. New York Airways operate a service connecting the central Manhattan business area, through the W. 30th Street Heliport, with the City's three main airports, La Guardia, International and Newark, and also run flights between the airports. The fares from the W. 30th Street heliport are: to La Guardia 5.00 dollars; to N.Y. International 7.00 dollars; and to Newark 6.00 dollars. These correspond to flight times of 9 minutes, 13 minutes and 9 minutes respectively, which represent a saving in time of $\frac{3}{4}$ - 1 hour. Less frequent services are also run to Teterboro airport and to the suburbs of White Plains and Stamford: the company have found that suburban services with their present single-engined Vertol 44Bs are insufficiently regular to compete with fast commuter trains (a previous service to Copeland was discontinued).

5. The helicopter traffic during 1959 at New York's airports and at the W. 30th Street heliport is shown in the following table.

	Passengers *	Mail (Tons)	Cargo (Tons)
Total Airports traffic	229,974	1,853	1,607
% change 1959/58	+ 33	- 2	+ 6
W. 30th Street Heliport	11,991	15	448
% change 1959/58	+ 125	+ 58	- 21
Total Traffic	241,965	1,868	2,055
% change 1959/58	+ 35	- 2	- 1

*Passengers boarding and disembarking: the actual number of individual travellers would be about half the totals.

6. Two-thirds of these passengers were handled at New York International and Newark Airports, while the remaining third used the W. 30th Street heliport or La Guardia. A significant part of the company's operation is the carriage of mail and freight. Much of this is carried as "make-up-weight" cargo on normal passenger schedules. In addition to five Vertol 44Bs for scheduled services the company also operate two Bell 47Js for charter and pleasure trips.

7. The company have recently signed a contract to purchase five Vertol 107 helicopters, with a trading-in of their five existing Vertol 44Bs at a depreciated value. The first of these new machines is to be delivered in 1961. With their increased speed and twin-engined performance journey times will be reduced and it is also expected that the greater regularity offered by these machines will enable suburban services to be extended. The company have issued a letter of intent for five Rotodynes with an option on a further fifteen provided the aircraft's noise is reduced to an acceptable level for city-centre operations. The Rotodyne is expected to open up services to such points as Philadelphia and Washington from the new heliport being built at Pier 6.

8. Chicago Helicopter Airways provide passenger and mail services between Midway Airport and Meigs Field, a small single runway airport extending over Lake Michigan and 5 minutes from the city centre; between O'Hare Airport and Meigs Field; and between the two major airports. The company operate eight Sikorsky S.58s and four Bell 47Bs. Clockwise triangle flights start at Midway every hour, proceed to O'Hare and Meigs Field and return to Midway. Simultaneous counter-clockwise services are operated over the same circuit. In all, 158 flights a day are scheduled on these routes.

9. The airport bus service between Midway and the city centre takes ¾-1¼ hours for a fare of 1.45 dollars. Taxicabs reduce this time to 30-45 minutes with fares in the region of 4.50 dollars. Over the same route the helicopter's flight time is 9 minutes at a fare of 6 dollars.

10. During 1959 the company carried 204,389 passengers as compared with the total for the preceding year of 108,911. The figure for February 1960

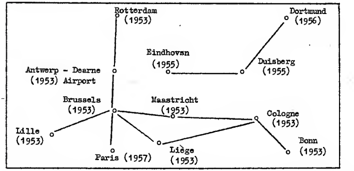
was 20,216 passengers, while on two peak days the numbers were 1,134 and 1,145. As at New York, the airports handle the bulk of passenger movements; traffic at O'Hare and Midway amounts to about three-quarters of the total. Limited suburban services are operated to Winnstka and Gary, but are very lightly loaded compared to the main airports - Meigs Field service.

11. The company has placed an order for six Sikorsky S.61 helicopters with delivery due to begin in 1961. These machines will be used to intensify the main triangular service and also reduce the travel times between stages. It is worth noting that, since the staging points are all airports, the problem of steep approaches does not arise to the same degree as for heliports in built-up areas, and the approach techniques adopted make full use of the ground space available.

12. Los Angeles Airlines operate a service between the International Airport and the city's far flung suburbs. Their present fleet consists of five S.55 and two S.51 helicopters. Five S.61 multi-engined helicopters are on order, and the company are considering the use of S-62s, single-engined turbine machines, for the mail and freight traffic on many of their routes. In 1959 the airline carried 41,000 passengers, which amounts to an increase of 37% over the previous year.

Inter-City Services

13. Other than a limited service in Italy connecting Milan with other industrial cities of the Po Valley, the only full scale scheduled service connecting city centres is that operated by SABENA, the Belgian airline, connecting major cities in France, Belgium, Germany and Holland. The full extent of this service is shown below, with the opening dates of the various heliports.



14. Helicopter routes are centred on the Brussels National Airport, where frequent helicopter services are run to a heliport at the Allse Verte, about 5 minutes from the city centre. The service was started with S.55 helicopters, but these were later replaced by S.58s. The annual development of traffic is shown below.

1953	3,833 passengers	1957	39,661 passengers
1954	13,338 "	1958	50,715 "
1955	16,299 "	1959	32,517 "
1956	17,157 "		

15. The company are looking to the multi-engined helicopter to give their operations a greater measure of regularity and to speed up schedules, thereby giving the helicopter more ability to compete with fast rail services. They are considering the use of multi-engined helicopters on a triangular service between London, Paris, and Brussels.

Heliports

16. A variety of sites are used as heliports: at New York's and Chicago's airports use is made of an area of the apron, and at Brussels Airport two special operating areas are set aside: at Cologne an acre of open space has been temporarily allocated for a heliport, and at Stamford a 75 ft. diameter pad has been sited in a 7½ acre field; small roof top sites have been built in Tokyo, in New York on the National Bank and in White Plains; and use is made of small fixed-wing airports, as at Paris-Issy and Meigs Field, Chicago.

17. More representative as genuine city-centre heliports are those in Brussels, Rotterdam and at W.30th Street in New York.

18. Allée Verte - Brussels. The site measures 2,000 ft. x 500 ft. at its widest points and has an area of about 18 acres, although not all the space is at present used. The original heliport possessed a terminal building, 160 ft. x 64 ft. In 1958 a 200-ft. long finger containing two waiting rooms was added, from which the passenger boards the helicopter. The present building contains a concourse, baggage and ticket counter, a small buffet and telephone kiosks. There is a 50,000-sq. ft. apron in front of the passenger building and two 80-ft. diameter landing pads. Fuelling facilities are provided but major maintenance and overhaul are conducted at the National Airport.

19. Rotterdam Heliport is situated in the heart of the business and commercial centre. Originally opened in 1953, it has twice been expanded, until today it measures nearly 9 acres. It contains a small terminal building fronting an apron and landing pad. From this central pad taxiways lead to three further pads, 120, 130 and 100 metres away. This allows an effective 200-yard obstruction-free distance over the heliport during take-offs and landings. 2-3 incoming and outgoing flights are operated through the heliport per day.

20. W. 30th Street Heliport, built in 1956, is 10 minutes by taxicab from Times Square and close to the Post Office and U.S. Parcel Post Buildings. It is sited by the river Hudson with a platform 400 ft. x 70 ft. and two 80 ft. x 80 ft. pads extending 40 ft. over the water. A small traffic building, 40 ft. x 20 ft. contains a waiting room, freight shed, ticket office and operations office: apron equipment, fire extinguishers etc., are accommodated in an adjoining shed. Hydrant refuelling facilities are available, with a small skiff for launching in the event of landing in the river (N.Y. Airways' helicopters, like those of SABENA and BEA, are fitted with float gear). Helicopters usually stop for only 2-3 minutes at the heliport during their scheduled runs.

21. The Port of New York Authority are building a larger heliport, of nearly 7½ acres, at Pier 6 close to the Manhattan financial district, from which services are due to start in 1961. The Authority plans to have a total of three heliports in Manhattan, and one each in Brooklyn, Staten Island and the City of Newark.

APPENDIX C

TYPES OF HELICOPTERS

HELICOPTER	ENGINES: TYPE AND NUMBER	NUMBER OF ROTORS	MAX. ALL UP WEIGHT	NUMBER OF PASSENGERS	CRUISING SPEED	MAX. RANGE	ROTOR DIAMETER	LENGTH OVERALL	MAIN WHEEL TRACK	STATUS
WESTLAND SIKORSKY WHIRLWIND (S-55)	1 x 750 h.p. LEONIDES MAJOR OR 1 x PRATT & WHITNEY R1340 OR (Piston) 1 x D.H. GNOME (Turbine)	1	7,800 lb.	8-10	85 m.p.h. (Piston) (75 kts) 105 m.p.h. (Gnome) (90 kts.)	335 miles (290 n.m.)	53ft.	62ft.	11ft. 3in.	In service
VERTOL 44B	1 x WRIGHT CYCLONE 1425 h.p. (Piston)	2	14,350 lb.	15	100 m.p.h. (85 kts)	280 miles (245 n.m.)	44ft.	-	-	In service
SIKORSKY S-58C (Note 1)	1 x WRIGHT CYCLONE 1525 h.p. (Piston)	1	13,600 lb.	12-18	100 m.p.h. (85 kts.)	260 miles (225 n.m.)	56ft.	65ft. 10ins.	-	In service
BRISTOL 171 SYCAMORE	1 x LEONIDES 550 h.p. (Piston)	1	5,600 lb.	4	90-110 m.p.h. (80-95 kts.)	255 miles (225 n.m.)	48ft. 6ins.	61ft. 11ins.	9ft.	In service
BELL 47	1 x LYCOMING VO 435 (Piston)	1	2,800 lb.	3	100 m.p.h. (85 kts.)	250 miles (220 n.m.)	37ft. 2in.	43ft. 5in.	7ft. 6in.	In service
BRISTOL 192 (Note 2)	2 x NAPIER GAZELLE (Turbine)	2	19,000 lb.	24	115 m.p.h. (100 kts.)	350 miles (305 n.m.)	48ft. 8in.	89ft. 9in.	10ft.	In production for the Royal Air Force
WESTLAND WESSEX (Note 3)	2 x NAPIER GAZELLE 13 (Turbine)	1	12,600 lb.	12	115 m.p.h. (100 kts.)	270 miles (235 n.m.)	56ft.	48ft. 2ins.	12ft.	Under development
VERTOL 107 (Note 4)	2 x GENERAL ELECTRIC 158 (Turbine)	2	18,400 lb.	23-30	155 m.p.h. (135 kts.)	390 miles (340 n.m.)	50ft.	81ft. 8in.	-	Due in service 1961/62
SIKORSKY S.61	2 or 3 x GENERAL ELECTRIC T58 (Turbine)	1	19,000 lb.	22-25	130 m.p.h. (110 kts)	385 miles (335 n.m.)	62ft.	72ft. 9in.	13ft.	Due in service 1961/62
SIKORSKY S.62	1 x GENERAL ELECTRIC T58 (Turbine)	1	7,500 lb.	8-12	90 m.p.h. (80 kts.)	230 miles (200 n.m.)	53ft.	62ft. 3in.	11ft.	FAA certificate July, 1960
WESTLAND WESTMINSTER (Note 5)	2 x NAPIER ELAND N.EL.16 (Turbine)	1	36,000 lb.	45	150 m.p.h. (130 kts.)	325 miles (285 n.m.)	72ft.	89ft. 3in.	19ft. 9in.	Prototype only; development discontinued
FAIREY ROTODYNE (PROTOTYPE) (Note 6)	2 x NAPIER ELAND N.EL.3 (Turbine)	1	33,000 lb.	40	170 m.p.h. (150 kts.)	-	90ft.	(Fuselage) 58ft. 8in.	26ft. 8in.	
FAIREY ROTODYNE (DEVELOPED) (Note 6)	2 x R.R. TYNE (Turbine)	1	53,500 lb.	57-75	200 m.p.h. (175 kts.)	440 miles (385 n.m.)	104ft.	(Fuselage) 64ft. 6in.	26ft. 2in.	Under development
BRISTOL 194 (Note 7)	4 x DE HAVILLAND GNOME (Turbine)	2	32,000 lb.	50-60	200 m.p.h. (175 kts.)	-	54ft.	110ft.	-	Projected

Note 1: Sikorsky S.58

Westlands have developed the Wessex I from this basic helicopter and powered it with a Napier "Gazelle" shaft-turbine. A further development, the Wessex II, with the two De Havilland "Gnomes", is due to fly later this year.

Note 2: Bristol 192

No order for the civil version of this aircraft has yet been placed, but some have been ordered for the Royal Air Force.

Note 3: Westland Wessex

A turbine powered derivative of the piston-engined S.58 helicopter which is used by SABENA; in later versions the weight may increase to 13,500 lb.

Note 4: The Vertol 107

This amphibious helicopter is being developed in both military and civil forms. Civil versions are intended to be available in 1961. Five of these helicopters have been ordered by New York Airways.

Note 5: Westland Westminster

Two versions of this aircraft were planned: a "flying crane" capable of carrying a five-ton load which has been flying since the 15th June, 1958, and a version capable of carrying 45 passengers. This aircraft is a derivative from the Sikorsky S.56, which is in use as a military aircraft only.

Note 6: Fairey Rotodyne

The prototype of this helicopter has now carried out a considerable amount of test and development flying. An enlarged version with Tyne engines is likely to be available in about 1965-66. Development flying and training with the small pre-production prototype may be carried out in the two preceding years.

Note 7: Bristol 194

The Bristol 194 is a suggested derivative of the Bristol 192. Each of the four engines is to be capable of individual control. The rotors would have six blades each. A feature of the design would be the use of stub wings, because the consequential reduction in load on the rotor would enable a higher cruising speed to be obtained. Typical stages envisaged are:- 100n-miles with a payload of 9,500 lb. (50 passengers); 200 n-miles with a payload of 8,500 lb (42 passengers). The future of this civil version depends on whether operators show sufficient interest.

APPENDIX D

PHYSICAL REQUIREMENTS FOR A HELIPORT

This preliminary estimate of the physical requirements for heliports assumes that all but minor maintenance is done elsewhere and that prolonged parking of helicopters is not allowed. As no fully-operational large civil helicopter* is yet developed, information about the effect of turbulence caused by the rotors could be obtained only from measurements using the prototype Westminster and Rotodyne aircraft. Such measurements as could be taken gave reason to expect that the effect on parked helicopters of others taking off or landing nearby could be controlled by blast screens, so that no space has been included to allow for greater separation between parking apron and landing pad to account for rotor turbulence.

Assumptions

2. The main use of helicopters is likely to be on short overseas routes, and the heliport must provide appropriate passenger handling facilities, including the necessary controls, and also space for vehicles to pick up, set down and be parked.

3. Future helicopters could well have up to 40-60 seats, rotor spans of the order of just over 100 ft. and fuselage lengths of up to 90 ft. The total length may exceed either of these dimensions in certain cases. Their weight will be up to 60,000 lbs. It is quite common for fixed-wing aircraft to be developed from their original versions over a period of years to give increased capacity or better performance. There is no reason to suppose that helicopters will not follow a similar trend of growth, and allowance for this has been made accordingly.

4. Helicopters are likely to have fuselages in shape not very different from those of fixed-wing aircraft, with generally similar cabin layouts. Fuel and servicing requirements will, according to present information, also be comparable with those of fixed-wing aircraft of similar capacities.

5. The best air traffic control studies that can be made in the absence of actual experience of high density helicopter traffic under instrument weather conditions indicate that, although 30 movements an hour might be obtained with a single pad, it would be prudent to plan on a maximum capacity of 25 movements an hour.

6. On the basis of experience with fixed-wing aircraft at London Airport, the minimum turn-round time, after balancing the needs of home and foreign based aircraft, might be 30 minutes, although BEA estimate it could be as low as 12 minutes. The apron comprises a large proportion of the total space needed, and estimates have accordingly been made on each assumption. For convenience in quoting a single figure, an estimate has also been made using an intermediate turn-round time of 22 minutes.

Size Requirements

7. A complete heliport may conveniently be divided into three distinct parts, which to a large extent can be considered independently once the potential traffic density is decided on:-

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* The multi-engined helicopters, for which heliport requirements are given in this appendix, are assumed to comply with the full safety requirements applicable to performance after an engine has failed. The heliport requirements for multi-engined helicopters unable to comply with such an engine-out performance would be closer to those for single-engined helicopters as regards pad areas, approach and take-off slopes and cleared areas.

(a) The take-off and landing area (referred to as the 'pad').

(b) The apron requirements, including provision for manoeuvring and parking certain vehicles.

(c) The passenger building and offices, including car parking and mail and freight facilities.

NOTE: The shapes of these areas, and hence the total ground requirement, will ultimately be affected by the shape and surroundings of a particular site and the number of levels available.

Take-off and Landing Area, and Approaches

8. The 'pad' is the area required for landings and take-offs. On present information an area of 400 ft. x 200 ft. will be adequate for multi-engined helicopters. Each available approach direction will require a pad in line with it, and since it will often be necessary to change the approach sector in use, in order to save space the pads for different approaches may be partially superimposed on each other. How far this arrangement is possible will depend upon the size and shape of the site.

9. The approach sectors (or funnels) begin at the 200 ft. edge of the landing pad and the sides splay outwards at 15° for a distance of 3,000 ft., at which point the funnel will be 1,800 ft. wide. Thereafter the sides continue parallel up to a distance of 2 n. miles from the pad, which is roughly the length of the 'straight-in' path likely to be followed by large helicopters of the future when approaching to land.

10. Estimates for the flight path gradients likely to be followed by future helicopters while descending to land or taking off have averaged 1:4, i.e. about 15°. On the basis of the safety factor employed for fixed-wing aircraft, it has been assumed that obstructions in the approach funnels should not exceed a slope of 1:8 from the edge of the landing pad for approaches made visually and 1:10 for funnels likely to be used by helicopters in instrument conditions. To take account of possible engine failure during the take-off of multi-engined helicopters, these slopes would become flatter after reaching a height of about 300 ft. The gradient of these outer slopes will largely depend upon the one-engine-out performance established for future helicopters.

11. Objects outside a funnel should not infringe a slope of 1:2 from its sides. The requirements for obstruction-free sectors are illustrated in Figure 2. In order to give a heliport an acceptable degree of operational efficiency, at least one sector for take-offs and one for landings should be aligned reasonably close to the prevailing wind direction.

12. To allow for the possibility of a helicopter "over-shooting" following an abortive approach to land after failure of an engine, it has been assumed that for regular use an approach sector should have a corresponding obstruction free sector extending from the opposite end of the pad to it. This "overshoot" sector can of course be the approach sector for the opposite direction. It need not be exactly opposite provided the overshooting helicopter can keep inside it without having to turn too sharply from the original approach path.

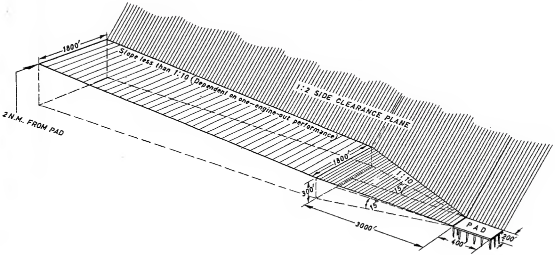
13. These requirements have been deliberately drawn up on a stringent basis, and operating experience or trials with future helicopters and approach aids will indicate whether they can be relaxed.

Apron Requirements

14. Apron requirements must take into account the following:-

FIG. 2

HELICOPTER APPROACH AND TAKE-OFF CLEARANCE PLANES


1800'
2 N.M. FROM PAD
Slope less than 1:10 (Dependent on one-engine-out performance)
1:2 SIDE CLEARANCE PLANE
1800'
1:10
15°
300'
15°
3000'
PAD
400'
200'

(a) The number and size of working stands (plus at least one stand for longer use during unserviceability or unavoidable prolonged waiting).

(b) Taxiways, including two-way access from apron to terminal building, and vehicle routes to stands.

(c) Space for servicing vehicles.

15. As regards the number of stands, without allowance for extensive night parking, the following numbers will be needed (see also para. 6):

Table I

MOVEMENTS PER HOUR	TURN-ROUND INTERVAL		
	30 minutes	22 minutes	12 minutes
5	4 stands	2-3 stands	2 stands
10	6 "	4 "	3 "
20	9 "	5-6 "	4 "
25	11 "	8 "	5 "

16. Helicopters can generally be taxied short distances if required. For the Rotodyne the wheel-base and rotor dimensions indicate a minimum stand of 130 ft. diameter assuming the helicopter taxies on to the stand but may be towed off. The taxiway width would need to provide a sufficient margin over the wheel-span (say 50 ft.) to cover the Rotodyne's 26-ft. track, with a total "cleared width" of 130 ft. to provide clearance from the rotor tips. This clearance could accommodate a service road.

17. In addition to aircraft stands, provision will have to be made near the apron for the necessary fire service equipment, for parking apron vehicles of various types and for fuelling facilities. To some extent all these will depend on the actual or designed capacity of the heliport, but the following might be regarded as reasonable for up to 10 movements an hour.

Fire services, apron vehicles,) ¼ acre
fuel stores, other vehicles, etc.)
Above this frequency, the space might be doubled.

Buildings, etc.

18. The range of 5 to 25 movements per hour by helicopters as large as those assumed in para. 3, might produce between say 200 and 1,000 passengers per hour, allowing for an average load factor of about 70% and providing some margin for occasional excess caused by weather delays.

19. Assuming that schedules are reasonably spaced, and that passengers make their own way to and from the heliport, between 100 and 500 passengers (to which must be added relatives and friends) might be in the buildings at any one time. The facilities would have to cater for a departure peak of perhaps 3 to 17 departing flights, and an arrival peak of similar numbers. This would involve the equivalent of one or two outbound 'channels', and two to five inbound 'channels' (the channel would doubtless be notional rather than physical and may in fact be only a check point). The rough space requirements are given in the following table, which includes, for comparison, comparative figures for Gatwick Airport.

	5 movements per hour (sq. ft.)	25 movements per hour (sq. ft.)	Gatwick* (sq. ft.)
Customs	5,000	13,500	6,500
Immigration	400	1,000	1,400
Airside waiting	3,000	10,000	2,500
Concourse, etc.	4,000	20,000	15,500
	12,400	44,500	25,900

*The number of passengers would be equivalent to about 13 large helicopter movements per hour.

In addition, there would be a need for certain office facilities, some of which would have to be on the ground floor, and accommodation for ground services such as air traffic control, telecommunications and navigational aids. Space for offices, restaurants, and car parks might be found on floors or roof areas above the ground floor allocation but below the landing pad and apron.

Freight

20. The likelihood of the carriage of freight by helicopter developing cannot be excluded, if only because it would have a stabilising effect on load factors. Probably the freight handled at a city-centre heliport would be mostly the light "parcels" type, but, even so, some provision would be necessary for its collection and handling, for bonded stores and for customs inspection facilities.

Car Parking and Set-Down Areas.

21. These have been estimated in Appendix E and are repeated in the table of total areas below.

Total Areas

22. From the foregoing the main space requirements would be:-

TABLE II

Movement Rate(per hour)	Landing Pad	Aprons*	Apron Services	Buildings (say)	Car Parks and Set-Down Areas	TOTAL
5	80,000 sq.ft. 2 acres	75,000sq.ft. (2-3 stands) $1\frac{3}{4}$ acres	10,000 sq.ft. $\frac{1}{4}$ acre	10,000 sq.ft. $\frac{1}{4}$ acre	20,000 sq.ft. $\frac{1}{2}$ acre	say 5 acres
10	80,000 sq.ft. 2 acres	100,000sq.ft. (4 stands) $2\frac{1}{4}$ acres	10,000 sq.ft. $\frac{1}{4}$ acre	20,000 sq.ft. $\frac{1}{2}$ acre	40,000 sq.ft. 1 acre	6 acres
20	80,000 sq.ft. 2 acres	175,000 sq.ft. (5-6 stands) 4 acres	20,000 sq.ft. $\frac{1}{2}$ acre	40,000 sq.ft. 1 acre	110,000 sq.ft. $2\frac{1}{2}$ acres	10 acres
25	80,000 sq.ft. 2 acres	250,000 sq.ft. (8 stands) $5\frac{1}{2}$ acres	20,000 sq.ft. $\frac{1}{2}$ acre	40,000 sq.ft. 1 acre	150,000 sq.ft. 3 acres	12 acres

* Based on 22-minute turn-round times.

Only items 1, 2 & 3 need be on one level, i.e. a platform, if other space is available for buildings and car parks.

23. The above estimates should only be used as approximations. For example, the platform area needed in practice at any particular site will be greatly affected by the shape available. Apron areas could also be reduced if it turned out that most movements would be by helicopters much smaller than the developed Rotodyne.

CAR PARKING REQUIREMENTS

1. We have made certain assumptions, based to a large extent on observations at West London Air Terminal and London Airport Central over the past two or three years. The assumptions include the following:-

(i) Passengers will be divided according to modes of transport to and from the heliport in about the following proportions -

70% taxis
30% private cars

These proportions are based on observations made at West London Air Terminal in 1958.
Because of present uncertainty regarding the extent of public transport facilities at a Central London heliport it has been assumed that all passengers who, on the basis of the 1958 West London Air Terminal observations, might have been expected to use public transport, will use taxis or private cars; the numbers likely to use public transport will in all probability be smaller than the errors contained in our estimates of traffic and this assumption.

(ii) There will be an average of about 1.5 air passengers per car or taxi; this figure is unlikely to be exceeded.

(iii) Cars and taxis setting down and picking up passengers and baggage will stop on average for two minutes at the face of the passenger building and no waiting will be permitted there.

(iv) Air passengers travelling for business reasons and wishing to leave their cars at the heliport will want to park on average for 2½ days, and cars being used to meet or set down air passengers may park for about one hour. This figure is very uncertain and liable to unpredictable variation.

Road Traffic: Picking up and Discharging Passengers

2. As an example, on the basis of 25 helicopter movements an hour and using these assumptions, we find that 600 passengers may generate about 400 cars or taxis, of which about 275 may be setting down passengers in departure peaks or picking them up in arrival peaks. If the average manoeuvring length of a car or taxi is taken as 18 feet, then about 160 feet of kerb space would be required to absorb cars or taxis arriving at the rate of 275 per hour and staying on average for two minutes, and 240 feet of kerb space for cars and taxis arriving at the rate of 400 per hour. Thus, if separate arrival and departure bays are adopted, a total of about 320 feet of kerb space may be required, and, if they are common, about 240 feet would meet requirements. These estimates may be regarded as upper limits since it is likely that the road traffic generated by air passengers at peak times will not be so sensitive to peaks as passengers are. Further, if the access road were wide enough to permit some form of double banking at the face of the passenger building, the estimated requirements might be reduced by up to 50%. In view of the restricted area likely to be available for a heliport in the centre of London and the probability that the terminal building will be fairly compact, double banking with islands separating the two streams appears essential.

Car Parking

Passenger (Short Term)

3. The bulk of private cars which will be arriving at the heliport will be either meeting or putting down passengers and will be parked for a period of about one hour. It is possible that occasionally the period may be extended by late arrivals or delayed departures, but the number of such cases will be relatively small and the overflow could be contained in the long-term parking area.

Passenger (Long Term)

4. It is difficult to make a useful prediction of long-term car parking requirements, since the demand is uncertain and will vary with the position of the individual site in relation to public transport facilities and accessibility to taxis. We have assumed that no use will be made of other parking facilities, and that kerb-side parking will be restricted on the side roads near the heliport.

5. If the demand for parking over periods greater than 18 hours by passengers travelling for business reasons at London Airport Central is taken as a guide, then the demand at a heliport handling 25 movements an hour might be for as much as 200-280 spaces. But since the purpose of siting a heliport near the centre of London is to do away with the long road journey to the airport which might encourage a person to leave his car to await his return, it is questionable how far the comparison can be applied. Nonetheless, we have taken the figures for London Airport Central as representing the maximum demand that might be expected. It is probable that time itself will clarify the problem: the initial scale of operations is likely to be small and, provided sufficient car parking facilities are made available to cover the first few years of operation, by the time it becomes necessary to expand the heliport or build a new one, a more accurate measure of the demand will have been gained. In considering the design of a heliport there is no overriding reason why long-term parking could not be accommodated in ancillary parks not physically within the confines of the heliport, but still forming an integral part of the heliport.

6. If the site contains a restaurant some members of the public will no doubt wish to use it, particularly if it offers a good view of the river, and it is reasonable that parking space should be accorded them. The precise amount will depend upon the size of the restaurant and the location of the heliport, but in our estimate of car parking requirements for passengers and friends we have allowed sufficient average parking time for the use of any restaurant facilities that may be provided.

Spectator Parking

7. Spectators may be attracted to the heliport in the early stages, though their numbers will vary from site to site. We have assumed that, as a matter of policy, they will be discouraged from entering the terminal building lest they impair efficiency of passenger handling, and that it will not be worth while to stress its roof sufficiently to take them. Should the site require a raised platform it is doubtful whether, unless it is near an open space, spectators would be attracted to the same extent, and to make provision for them would call for special access and safety measures on the flight deck. If they are admitted provision will have to be made for their cars.

Staff and Business Visitor Parking

8. It is impossible at present to go beyond a suggested standard of one car space for every 500 sq. ft. of gross floor space used for offices, shops, restaurant or canteens. Extra provision may have to be made for aircrew parking depending upon the operation pattern.

G.P.O. and Service Vehicle Parking

9. In addition, an area will have to be provided, preferably within the building, for the parking of G.P.O. vans and the loading and unloading of vehicles serving the building. If possible this area should have its own service road with its own entrance to the heliport. The size of the area could not be determined without detailed discussion with the G.P.O., but the areas suggested in Annex A should be more than enough.

Taxi Ranking

10. Space would be required for a taxi rank for passengers arriving by air, and this could be split into a main and feeder rank. Figures are suggested in Annex A.

Conclusions

11. We consider that the aim should be to ensure that the heliport contains within it sufficient parking space to cope with the road traffic which is generated. The areas allocated under paras. 2, 4, 6 and 8 will vary according to the location and physical characteristics of the site, and, lacking more specific data of the particular types of demand created by helicopter services, Annex A gives in tabular form the car parking requirements that might be appropriate to different volumes of traffic.

Estimated Requirements for Car Parking, Passenger Building Frontage Kerb Space and Taxi Rank at a Central London Heliport

Aircraft Movements/Hour (SBR)	5 - 7	15 - 18	25
Passenger Movements/Hour (SBR)	30	350	600
Kerb Space Requirement			
No. of Cars and Taxis/Hour	20	240	400
Kerb Space Requirement at front of Passenger Building	40 ft. ✗	150 ft. ✗	240 ft. ✗
Car Parking			
Requirement for Short-Term Parking	20	70	120
Possible Requirement for Long-Term Parking	10 - 15	130 - 180	200 - 280
Totals	40 spaces 9,000 sq.ft.	250 spaces 62,500 sq.ft.	400 spaces 100,000 sq.ft
Taxis			
No. of Taxis required during an arrival peak hour (SBR)	10	120	200
Taxi Rank Space Requirement	5 1,250 sq.ft.	25 6,250 sq.ft.	40 10,000 sq.ft.
Area for GPO and service vehicles	3,000 sq.ft.	5,000 sq.ft.	8,000 sq.ft.
Staff Parking	7,000 sq.ft.	19,000 sq.ft.	33,000 sq.ft.

✗ If the arrival and departure bays at the front of the Passenger Building are not common, then the estimated kerb space requirement is 40 feet, 200 feet and 320 feet when there are respectively 30, 350 and 600 passenger movements/hour.

APPENDIX F

THE HELICOPTER NOISE PROBLEM

The problem of helicopter noise is a variant of the wider question of noise and its effect upon human activity, which has been under study for a considerable time. Although much progress has been made, there are still many issues which require clarification and a great deal of research is still in progress in a number of countries.

Units and Standards

2. There is considerable complexity in the choice of units in which objective measurements of noise should be expressed to give meaningful indications; indeed, it is now recognised that no single measure yet proposed is adequate for all purposes. Since this report is concerned primarily with the noises of helicopters in relation to those of street traffic, and since these noises are not too different in character, it is best and simplest to give numerical information in terms of the internationally agreed unit of loudness level, the Phon[x], the loudness levels being computed from measurements by the method proposed by S.S. Stevens. An increase (or decrease) of 10 phons doubles (or halves) the loudness.

Loudness levels of some familiar noises

3. In order to help in the appreciation of the loudness levels for helicopters given in a later paragraph, the levels of some familiar noises are given below:-

	Phons
(i) Aircraft over Central London (depending on type and height) -out of doors	up to 95
(ii) Traffic noise - Pavement of Kingsway - passing buses	95
Quiet back street - no traffic	70-75
(iii) In the home - living room bordering on a fairly busy road with windows closed	65
(iv) Inside 3rd floor office overlooking Kingsway - windows closed	75
(v) Inside Underground Train	100

4. In general it appears that the background noise on the pavements of most of London's back streets is around 70-75 phons, but for brief periods during the passage of heavy traffic this level will be raised. In open courtyards the screening effect produced by surrounding buildings may reduce the level to 70 phons, or rather less in certain very favourable circumstances. A heavy traffic flow along Kingsway has been found to generate loudness levels ranging from 85-95 phons on the pavement at the faces of the buildings.

5. Street noise is usually less apparent in the upper floors of buildings to an extent depending in some degree on the width of the street and the nature and height of the buildings. In certain typical instances the fall has been measured as around 5 phons at the 7th floor and 10 phons at the 14th floor.

Noise heard indoors

6. The level of external noises heard inside rooms depends on the sizes

---

[x] It should be noted that Phons, being basically logarithmic, cannot be added arithmetically. In general, when several noises are heard simultaneously the loudest predominates, the lesser ones being unimportant. When two simultaneous noises are of equal loudnesses, the sum of the two is only about 3-4 phons louder than either.

of the windows and the degree to which they are open, to some extent on the construction of walls and partitions and the nature of the furnishings, and also on the positions of the windows in relation to the noise source. As a guide it may be taken that loudness levels in the open air should be reduced by around 20 phons in estimating their worst effect inside rooms with windows closed, by about 15 phons if the windows are opened slightly for ventilation purposes, and by 5 phons if windows are fully opened. The noise reduction afforded by well-designed and well-fitted double windows is, of course, much greater, reaching 40 phons in favourable circumstances. The fitting of such windows, however, raises serious problems of ventilation, and their effectiveness is in practice often reduced by noise 'leaking' into the rooms from other parts of the building.

7. Voice communication, involving telephoning or discussion, is one of the more important human daytime requirements. A good deal of work has been done on interference with speech communication, and the criteria given in the following Table may be regarded as fairly well established.

TABLE I

Subjective Rating for Noises affecting Voice Communication

Loudness Level in Phons Inside Private Offices	Rating ø	Voice Communication maintained by:
100	Intolerable	Voices very loud at 1 ft.
90	Unpleasantly noisy	Voices raised at 1 ft. Voices very loud at 2 ft.
80	Noisy	Normal voices at 2 ft. Voices raised at 4 ft. Voices very loud at 6 ft.
70	Moderately noisy	Easy and natural voice levels
50	Quiet to very quiet	

ø Assuming the noise to be continuous or nearly so: infrequent noises of short duration would obviously be less important.

Helicopter Noises

8. The main sources of helicopter noise are the power plant, the main rotor and, when applicable, the tail rotor, with in some cases a contribution from the gears. Most of the noise of small piston-engined helicopters is contributed by the engine exhaust, and this can be, and often is, reduced by the use of silencers. Gas turbine helicopters produce relatively little engine noise, and the main sources of noise are the rotors, particularly the tail rotor. In the case of present tip-jet types, the principal noise in the first and last stages of flight is that of the tip-jets.

9. Since the noise emitted by a particular helicopter depends largely on the power used, it is necessary to have in mind the various stages of operation during take-off, landing and cruising:-

Take-off

(a) Running up engines to take-off power,

(b) a near-vertical climb to a few hundred feet,

(c) a climb at a more or less steep angle to cruising altitude, and

(d) level flight at cruising altitude, normally at reduced power.

The operation of the Rotodyne is somewhat different from that of conventional helicopters, in that at some stage (probably during phase (c)) the air speed reaches 100 knots, when the tip-jets are extinguished and the aircraft flies as an autogyro powered by gas-turbine engines driving ordinary propellers.

Landing

(e) A descent from 1,000 ft. or above to a few feet above the pad (initially at reduced power) but with an increase in power in the later stages,

(f) a hover of short duration but high power above the pad, and

(g) the final touchdown.

The Rotodyne may start its descent in the autogyro configuration, but will have brought its tip-jets into operation before stage (f).

10. The best measurements available of noises of several current helicopters (some still in the prototype stage) measured out of doors are given in Table II, in which the entries are annotated to correspond to the sequence given in para.8. In the case of take-offs and landings, the noises quoted are the maxima, with the aircraft directly overhead at 500 and 1,000 ft. from the pad.

11. It is evident from the Table

(a) that the noises of all helicopters when cruising at about 1,000 ft. are roughly comparable with those of noisy road traffic, and

(b) that, in general, turbine-driven helicopters are appreciably less noisy than piston-engined types; the Westminster (36,000 lbs.) is only about as loud as the Whirlwind (7,800 lbs.)

12. Peak noises heard from individual flights at a given measuring point do not, however, tell the whole story. The area affected by the noise has to be estimated and the very important factors of duration and repetition rate should be allowed for. Though these factors are still the subject of research, Figure 3, which shows the isophon curves (contours) for the 95 and 85 phon levels for different types of helicopter, gives a general indication of the likely spread of noise around helicopters landing and taking off on a single heading. The curves must be interpreted with care; we have taken the Rotodyne, the Westland Westminster and the Bristol 192 as examples of the three main classes of helicopters at present under development, and the eventual types of aircraft may have noise characteristics different from the versions actually tested; and the helicopters are not strictly comparable in size.

13. In order to give a rough guide, the periods when noise will exceed 85 phons in the open air at three points around the pad for the three types of helicopter are given in Table III: A is 1,000 ft. from the pad under the take-off path; B_1 (and B_2), 1,000 ft. from pad at right angles to the line of flight; and C, 1,000 ft. from the pad under the landing path. Further from the pad, the duration falls off, at first slowly but then more quickly, to reach zero at the 85 phon contour.

Table III

Type of Helicopter	Duration in Minutes		
	A	B_1 (and B_2)	C
(a) Tip-jet Propulsion			
Landing	½ - 1	1	1½
Take-off	1½ - 2	1½	1-1½
(b) Large Single Rotor			
Landing	less than ½	less than ½	½
Take-off	½	½	less than ½
(c) Twin Tandem Rotor			
Landing	-	-	½
Take-off	½	-	-

TABLE II

Helicopter Noise Levels (out of doors). Loudness Levels in Phons

Helicopter Type	No. of seats	TYPE OF OPERATION					
		Hovering before take-off	Taking off - Under Flight Path		Cruising - Under Flight Path	Landing - Under Flight Path	
		at 500 ft. from pad	at 500 ft.[ø] from pad	at 1000 ft. from pad	altitude 1000 ft.	at 1000 ft. from pad	at 500 ft.[ø] from pad
Westland Widgeon[x]	4	-	110	104	87	95	100
Westland Whirlwind[x]	8	95	103	99	90	99	103
Westland Wessex[+]	12	95	104	93	88	100	104
Westland Westminster[+]	45	98	101	93	90	100	104
Bristol 192[+]	24	90	100	-	78	-	95
Vertol 107[+]	23-30	85	90	-	78	-	109
Fairey Rotodyne[ƒ] (Tyne Engines)	57	105	112	110	96	110	115
Stage (ref.para.8)		Stages (a) & (f)	Stage (c)		Stage (d)	Stage (e)	

[x] Piston engines driving rotors.

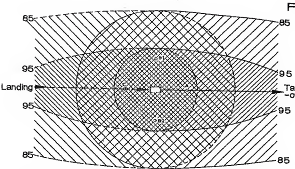
[+] Gas-turbine engines driving rotors.

[ƒ] Gas-turbine engines providing tip-jet propulsion on take-off and landing. An allowance of 10 phons has been made to cover the reduction in noise expected with the use of Tyne engines, instead of the Eland engines, on the present prototype.

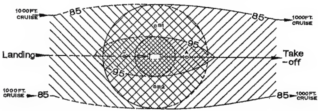
[ø] See, however, the detailed assessments for the three sites chosen.

To permit comparison, the figures are mean values given to the nearest phon. In practice there will, of course, be minor fluctuations in particular cases.

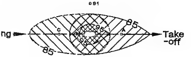
FIG. 3


85
85
B1
95
95
Landing
C
A
Take -off
95
95
B2
85
85

(a) TIP JET PROPULSION

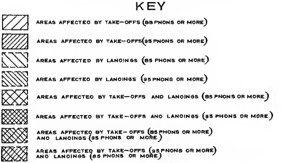

1000 FT. CRUISE
85
85
1000 FT. CRUISE
B1
95
Landing
C
A
Take -off
95
B2
1000 FT. CRUISE
85
85
1000 FT. CRUISE

(b) LARGE SINGLE ROTOR


B1
85
Landing
C
95
A
Take -off
95
85
B2

(c) TWIN TANDEM ROTOR
95 and 85 phon contours

KEY


AREAS AFFECTED BY TAKE-OFFS (85 PHONS OR MORE)
AREAS AFFECTED BY TAKE-OFFS (95 PHONS OR MORE)
AREAS AFFECTED BY LANDINGS (85 PHONS OR MORE)
AREAS AFFECTED BY LANDINGS (95 PHONS OR MORE)
AREAS AFFECTED BY TAKE-OFFS AND LANDINGS (85 PHONS OR MORE)
AREAS AFFECTED BY TAKE-OFFS AND LANDINGS (95 PHONS OR MORE)
AREAS AFFECTED BY TAKE-OFFS (85 PHONS OR MORE) AND LANDINGS (95 PHONS OR MORE)
AREAS AFFECTED BY TAKE-OFFS (95 PHONS OR MORE) AND LANDINGS (85 PHONS OR MORE)
SCALE OF FEET
1000
500
0
1000
2000
3000
4000
5000
6000
7000

14. It should be noted that variations in meteorological conditions will affect the performance of the helicopter on take-off and landing, and hence the spread of noise and its duration, and also the atmospheric absorption of sound. The curves and duration figures apply directly to the noise measured in free air over open ground, and in built-up areas they will need modification to take account of the shielding effect of large buildings, and, equally, in applying them to particular buildings or rooms within buildings, allowances must be made for the attenuation due to the building itself.

Operations from Raised Platforms

15. Operations from a platform raised about 50 ft. from ground level will be required at each of the short-listed sites. The effect of this on the noise problem will be marginal, as the proportionate increase in helicopter height will not be great save in the stages of flight near the heliport. In certain circumstances the lower floors of the nearest buildings will be screened by the platform, but this advantage will be offset to a greater or lesser extent by the fact that in many cases property somewhat further away might lose some of the screening otherwise afforded by the 'inner ring' of buildings.

APPRAISAL OF SITES

(1) BATTERSEA WHARF (PLAN II)

Heliport Layout

The Site: At ground level, the site is below the railway on the east and Queenstown Road on the west, and contains a small goods depot and sidings. The British Transport Commission, who own the site, plan to use it as a working area during the rebuilding of Grosvenor Railway Bridge in 1961-65.

Heliport Features: Immediately north-west of the site are the towers of Chelsea Bridge and, to overcome these obstructions, a heliport platform would have to be at least 80 ft.* above ground level. The site itself is wedge-shaped with a river frontage of about 375 ft. tapering to the south to a width of 150 ft., giving an area of 8.2 acres. A platform within the ground level confines of the site could contain only a substandard pad plus 5-6 working stands, but at 80 ft. a platform extending over the river, and possibly over the railway lines as well, could give enough area for a full size pad and an increase in parking area - to contain at least 6-12 working stands. There would be scope to expand the platform over the railway lines as needed.

Terminal Facilities: A platform at 80 ft. would allow space for 3, or even 4, floor levels of nearly 8 acres each below the flight deck, which, together with the area beneath the arches of the railway bridge, would create more than enough space for car parking and terminal facilities.

Construction: The construction of a heliport could be phased in with the bridge works. The Port of London Authority might, however, object to supports extending out from the bank, in which case to cantilever the platform out over the river would add significantly to the building costs.

Convenience to Traffic

Ease of Access: The travel time by car or taxi between the site and Grosvenor Square would be 13-16 minutes, and between the site and the Mansion House 20-22 minutes. The site is badly served by public transport- only one bus route passes over Chelsea Bridge, but Battersea Park railway station nearby is on the main line to Victoria.

Road Access: Chelsea Bridge is already heavily loaded with traffic, and the additional vehicles travelling to and from the heliport as the movement rate increased could require the improvement of the northern bridgehead earlier than might otherwise be necessary. Many vehicles travelling to and from the site would pass through the Victoria Station area, which is already heavily congested.

Operational Features

Obstruction-free Approaches: The dominant obstructions are the bulk and chimneys of Battersea Power Station and the gasholder south of the site. A platform at 80 ft. would allow approaches in good weather along the line of the river, but the whole quadrant from the east around to the south would remain obstructed by the power station. Two approach directions reasonably close to the prevailing wind, each with obstruction-free.

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[*] For convenience all heights are quoted as above ground level.

[+] The times quoted represent present average journey times at different periods of the day.

overshoot paths, would be available. Westerly take-offs would be possible over the river and the park and the presence of an open space under the main take-off directions would contribute to safety.

Operational Use: There would be good river approaches for use by single-engined helicopters in good weather, although it might be necessary to extend the platform over the rail and road bridges east and west of the site. For multi-engined helicopters using all approaches the usability* would be 99%.

Amenity Interference

Direct Effects: The goods yard and shed on the site are not in continuous use, but the depot is occasionally brought into service to handle important traffic, including mail, at peak periods. A heliport built over the railway lines would have to avoid interfering with signals, etc., but otherwise the immediate disturbance of activity should not be severe.

Noise Features

Location: The immediate surroundings of the heliport would be reasonably free of noise-sensitive areas, but within a quarter of a mile of the site there is part of the Churchill Gardens Housing Estate, the Lister Institute of Preventive Medicine and an area soon to be developed as a housing estate. The passage of trains, power station activity and the fun-fair in Battersea Park already create quite a high level of background noise. The presence of the park and the river near the site would allow a fairly wide area in which noise could attenuate without causing nuisance.

Climb and descent+ would be made over the following :-

1. Landing 022° T/Take-off 202°T:

Battersea Park, up to nearly 3,000 ft. from the pad (York and Prince of Wales Mansions would be on the eastern fringe of the funnel 2,000 ft. - 2,500 ft. from the pad); the remaining 1,000 ft., over the residential areas south of the park, which contain one school.

2. Landing 076°T/Take-off 256°T:

Battersea Park and the river Thames.

3. Landing 202°T/Take-off 022°T:

The river, Grosvenor Railway Bridge and railway lines up to 1,000 ft. from the pad: from 1,000 ft. - 4,000 ft. from the pad, the residential areas south of Victoria Station.

4. Landing 256°T/Take-off 076°T:

The river, up to 2,000 ft. from the pad, but near the Churchill Gardens Housing Estate: thereafter, the river and the residential areas on the north bank.

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*The percentage of time during which helicopters can land and take-off safely on the available approaches. We have considered only the effect of cross-winds on landing and take-off; an overall figure for usability would require a further reduction for bad visibility. The minimum overall usability generally accepted for a fixed-wing airport is 95%.

+Taking the performance features shown in Figure 1, helicopters landing and taking-off could be expected to be about 1,000 ft. above pad level when 4,000 ft. from the heliport. For clarity, the horizontal distance between the pad and the various sensitive areas under the approach sectors is given: the height of helicopters may be gauged from comparison with Figure I, and an indication of noise levels may be gained from comparison with Table II in Appendix F.

Preferential Use of Approaches: If the majority of take-offs were confined to 202°T and 256°T and landings to 256°T, the usability of the site in terms of wind conditions alone would be 97%, but the approach 256°T lies close to the power station chimneys, the effect of which, in relation to poor visibility and low cloud base conditions, would be to reduce the usability for multi-engined operations to 91%.

(2) GROSVENOR ROAD, WESTMINSTER (PLAN III)

Heliport Layout

The Site: The site contains a Main Drainage Pumping Station, the Grosvenor Canal Dock and Basin, and the Westminster City Council's Refuse Disposal and Works Depot, some blocks of residential premises and some offices. The area is zoned partly for light industry, partly for commercial activity and to a small extent for residential use.

Heliport Features: To provide sufficient space, whils still allowing normal use of the space beneath to continue, and to give the necessary clearances over nearby buildings, the platform for pads and apron would have to be raised to about 60ft. above ground level. By demolishing some office and residential property a 10-acre platform could be provided to contain an area for landings and take-offs plus up to 8 working stands according to the approach in use, without hampering the movement of helicopters between apron and pad. Expansion would be very difficult, and could only be achieved by further demolition or by extending the platform over the railway lines.

Terminal Facilities: The space available below the platform for terminal facilities would be limited if the use of the Pumping Station and Refuse Disposal Depot were to continue. Access to and from the site direct from Grosvenor Road would be impracticable and could best be provided from Ebury Bridge Road. Vehicle entrance and exit would have to be from the side roads, and a separate entrance for the steady flow of large refuse-collection vehicles would have to be provided.

Construction: Apart from the demolition of residential and office buildings, the construction of a heliport would probably entail rebuilding the Pumping Station at considerable cost. The construction programme would also be prolonged by the need to avoid interfering with the present activity on the site.

Convenience to Traffic

Ease of Access Cars would take 12-16 minute travelling to and from the West End, and between 19-21 minutes to and from the City. The nearest underground stations, Sloane Square and Victoria, are both about half a mile from the site and only one bus route passes the site.

Road Access: As at Battersea Wharf, much of the traffic to the heliport would travel through the Victoria area, where conditions are already congested. Heliport traffic would also hasten the need to improve the intersection at the northern end of Chelsea Bridge.

Operational Features

Obstruction-free Approaches: The Lister Institute, the proposed new Chelsea Barracks and other buildings north-west of the site, Battersea Power Station, the towers of the BOAC building, Westminster Cathedral and other spires and blocks of flats would probably be critical obstructions. In spite of these, adequate approach and overshoot paths would be available roughly north-east/south-west, with additional approaches from north-west/south-east that are only slightly substandard.

Operational Use: If the Pumping Station were demolished, the site would have limited access for single-engined helicopters. With multi-engined helicopters making use of all the available approach and take-off sectors, the usability of the site in respect of crosswinds would be over 99%.

Amenity Interference

Direct Effects: As the result of demolition to build the heliport, about 300 residents and 300 office workers would be displaced. The presence of the heliport platform, or its later expansion, would directly interfere with the daylighting of some of the properties adjoining the site, and probably displace a further 1,000 people.

Noise Features

Location: Though the south side of the site faces the river, and the railway into Victoria Station passes by on the east, there are 7,500 people living within a quarter of a mile on the north of the river.

Climb and descent would be made over the following:-

1. Landing 033°T/Take-off 213°T:

   The river and Battersea Park.

2. Landing 213°T/Take-off 033°T:

   Up to 600 ft. from the pad, the railway lines, but thereafter the residential areas south of Victoria Station (Westminster Cathedral would be roughly 4,000 ft. away).

3. Landing 312°T/Take-off 132°T:

   The river and the industrial area of Nine Elms.

4. Landing 132°T/Take-off 312°T:

   Chelsea Barracks would be very close to the site, and further away are the residential areas of Belgravia and Chelsea.

Preferential Use of Approaches: 213°T would be the main take-off direction and is also free of residential areas: the only approach sector reasonably free of residential areas is 312°T, which is badly aligned to the prevailing wind. Were multi-engined operations confined to these two sectors, crosswinds would reduce the usability of the site to 96%.

NINE ELMS GOODS YARDS

We have studied a number of possible sites in the large industrial area between the main railway into Waterloo Station and the reach of the Thames from Battersea Power Station to Vauxhall Bridge. The choice of the best operational site would be influenced by the high obstructions east and west of the site: Battersea Power Station to the west and two proposed high buildings to the east, one of which is to be used as a television centre and the other as offices. Their effects are best overcome by siting a heliport roughly midway between them, over an area at present containing the Meux Brewery. We have found two sites that conform closely to this requirement and we shall treat these under the headings of A, just west of the brewery, and B, just east of the brewery.

(3) SITE A (PLAN IV)

Heliport Layout

The Site: The ground area is divided into two parts by Nine Elms Lane. The northern part has a frontage of approximately 500 ft. on to the river and a depth of 50-150 ft. It is owned and occupied by the North Thames Gas Board, Meux Brewery and the British Transport Commission. The southern part is irregular in shape with an acreage of about 4½ acres. It consists of cleared land, the main part of which is owned by the North Thames Gas Board, Meux Brewery and the London County Council.

Heliport Features: In order to allow sufficient headroom for vehicles to pass along Nine Elms Lane, the heliport platform would have to be at least 20 ft. high, and, to allow space for suitable pads beside the river, would need to be extended some 100-200 ft. over the river. The platform would then be 9 acres in area, and could contain pads for the available approach directions beside the river and space for 7 parking positions, whose position would vary according to the pad in use. The shape of the site does not lend itself to an economic distribution of parking space nor to completely free movement between pad and apron.

Terminal Facilities: The whole area beneath the platform, other than that of the road, would be available for car parking and terminal facilities.

Construction: Subject to obtaining the land, the construction of a heliport should not create undue difficulty.

Convenience to Traffic

Ease of Access: The journey time by car or taxi between the site and Grosvenor Square is 15-19 minutes, and between the site and the Mansion House 17-19 minutes. Some interruptions are caused to the flow of traffic passing along Nine Elms Lane by two level-crossings. The area is some distance from the nearest Underground Station, although the Victoria tube extension could conceivably be pushed southwards to provide a station reasonably close to a heliport in this area. Vauxhall Station, on the main line into Waterloo, is about half a mile away. Three bus routes pass the site, two of which connect with the central area.

Road Access: Road approaches from the West End will be improved in the next few years by the construction of a two-level intersection south of Vauxhall Bridge and the widening of the northern bridgehead. The intersection of Nine Elms Lane and Wandsworth Road would also need improvement to meet the growth in heliport traffic.

Operational Features

Obstruction-free Approaches: To the west and south-west, operations would be restricted by the obstructions arising from the Battersea Power Station and a gasworks. To the east, a granary and cranes close to the site, and the proposed television building would limit operations. Almost immediately opposite on the north bank is Dolphin Square, which would prevent approaches from a north-north-west direction. These obstructions would leave the site with three approach directions, but none of them would be supplemented by a direct overshoot path.

Operational Use: The site would be open to use by single-engined helicopters. The usability for multi-engined machines, in view of all the available approaches, would be just over 99%.

Amenity Interference

Direct Effects: Two buildings just west of the site would have to be demolished to give the necessary clearances. The British Transport Commission intend to use the part of the site in their ownership as a working area for the Grosvenor Railway Bridge reconstruction, and their plans would have to be modified.

Noise Features

Location: Though the area around the south of the site is predominantly industrial with a high background noise caused by goods yard and gas works activity and the frequent passing of trains on the main line track into Waterloo Station, the area immediately opposite the site on the northern bank is mainly residential - Dolphin Square is about 800 ft. away - with roughly 2,000 people in all living within a quarter of a mile.

Climb and descent would be made over the following:-

1. Landing 098°T/Take-off 278°T:

The river Thames.

2. Landing 220°T/Take-off 040°T:

The river Thames, passing over Vauxhall Bridge at midstream about 2,000 ft. from the site.

3. Landing 337°T/Take-off 157°T:

Up to 1,500 ft. from the pad, railway or industrial activity; but, from 1,500-4,000 ft. from the site, the residential areas of Wandsworth and South Lambeth.

Preferential Use of Approaches: With take-offs confined to 278°T and landings to 220°T on the majority of occasions, the site would still be usable by multi-engined helicopters for 98% of the time so far as cross-winds were concerned.

(4) SITE B (PLAN V)

Heliport Layout

The Site is also divided by Nine Elms Lane; with 9 acres on the south and a further 3 acres north of it beside the river. The area is almost entirely composed of railway property, with large goods sheds which are in constant and heavy use on the southern part.

Heliport Features: A 13-acre platform could be built over this area at a height of 50 ft. above ground level, which would allow the goods depot to continue in use. There would be enough space for an operating area with up to 9 working stands depending upon the approach direction in use. The site is sufficiently large to allow unhampered movement between apron and pad and the question of expansion should not arise.

Terminal Facilities: Since the work of the goods yard would have to continue it would not be possible to make use of all the area below the flight deck; nevertheless about 16 acres in all would be available beneath the platform, of which only about half would be required for ancillary accommodation.

Construction: Apart from its size and height, the construction of a heliport would be complicated by the need to install supports clear of railway lines and by the need to avoid interference with the working of the goods depot.

Convenience to Traffic

The site is about 200 yds. east of Site A, and the same travel times, etc. would apply.

Operational Features

Obstruction-free Approaches: The main obstructions would be the tower and chimney of the brewery immediately alongside the site on the west, and the granary and cranes beside the river platform and the proposed television centre and Esso building to the north-east. In spite of these, three pairs of approach and overshoot sectors are possible (using the take-off sector 276°T to supplement both the 276°T and 249°T landing directions for overshoots), with one other sector available for take-offs. An approach and take-off sector from the north-east passing over the river could be provided if the platform were extended further over the river, or if the granary and cranes beside the platform were suitably modified.

Operational Use: The site would have a virtually 100% usability for multi-engined operations using all approaches. The site is close enough to the river for single-engined operations.

Amenity Interference

Direct Effects: Some interference with goods yard activity could be expected during the period when the heliport is under construction, and the presence of a high platform would seriously affect adjoining properties east and west of the site.

Noise Features

Location: The immediate area in the semi-circle east-south-west is industrial, with a high level of background noise caused by goods yard activity and passing trains on the main line, but south of the railway viaduct there is some residential development. The river separates the site from the dwellings on the north bank - it being further east than site A. Dolphin Square is about quarter of a mile away - and the residential population within quarter of mile is about 2,500. The pads serving the main flight directions are further inland so that the highest intensity of noise will fall on the goods yard.

Climb and descent would be made over the following:-

1. Landing 096°T/Take-off 276°T:

The river Thames up to 2,000 ft. from the pad; thereafter, the north bank of the river up to Grosvenor Railway Bridge.

2. Landing 029°T/Take-off 209°T:

Railway or industrial activity up to 3,000 ft. from the pad; from 3,000 ft. - 4,000 ft., the Patmore Housing Estate.

3. Landing 249°T/Take-off 069°T:

Industrial activity up to 2,000 ft. from the pad, with predominantly industrial areas below the flight path for a further 1,000 ft., even though the fringes of the funnel would be over residential properties. Between 3,000 ft. and 4,000 ft., the residential areas of Kennington.

4. Landing 276°T/Take-off 096°T:

Predominantly railway or industrial areas up to 2,500 ft. from the pad; thereafter, residential areas.

5. Landing 170°T/Take-off 350°T:

Within about 1,000 ft. of the pad, the river; thereafter, the residential area of Pimlico.

6. Landing 350°T/Take-off 170°T:

Industrial or railway activity up to 1,500 ft. from the pad; from 1,500 ft. - 4,000 ft. from the pad, the residential area of Wandsworth.

Preferential Use of Approaches: With take-offs mainly confined to 209°T or 276°T and landings for the most part on 249°T and 276°T, there would be an effective "noise clearway" of at least 2,000 ft. beneath the approaches near the site, while the usability for multi-engined helicopters would remain about 99%.

SUMMARY

In giving our preference to Site B we have been influenced by its relatively good operational features; it has more approaches and better overshoot paths than site A, and the difference could not be made up except by raising the platform at site A very much higher. It shares with site A the advantage of a river frontage for single-engined operations, but also, since the main operating area will be further inland, the hub of noise will be centred on the railway yards and further from the very sensitive development on the north bank.

(5) WATERLOO STATION (PLAN VI)

Heliport Layout

Heliport Features: Owing to the high frontage of offices to the station, the lowest a heliport platform could be built would be 73 ft. above the level of the station concourse. The size of the roof is 11 acres, which could contain a landing area and up to 9 working stands depending upon the pad in use. The shape would allow unhampered movement between pad and apron. The need to expand the site would be unlikely to arise, but the platform could be expanded, if needed, either to the south-west or over the railway lines leading out of the station.

Terminal Facilities: The space beneath the heliport platform would be in constant use, and it would be exceedingly difficult to introduce deck levels above the working level of the station even when services had been fully electrified. As a result, car parks and terminal facilities would have to be provided elsewhere. But the problem of giving vehicles the necessary access to the flight deck would remain.

Construction: The construction of a platform at the necessary height raises formidable difficulties: the station itself is built over brick arches and the supports would have to extend some way below station level; the spacing of supports would have to take account of the necessity to allow clearances between railway tracks and to avoid interference with passenger and baggage movement along the platforms; and, in certain cases, difficulties might be created by the presence of underground railway tunnels. To extend the site would also be very costly.

Convenience to Traffic

Ease of Access: The site is between 14 - 17 minutes by car from Grosvenor Square and 10 -13 minutes from the heart of the City. The station is on the Bakerloo, Northern and City underground lines, with very good surburban rail connections and a number of bus routes passing nearby.

Road Access would be via Waterloo Bridge, which already carries a large volume of traffic and whose approaches are being improved. The roads in the vicinity are heavily loaded and could not be expected to take an additional large volume of traffic without some improvement. Westminster Bridge could not cope with a substantial volume of heliport traffic without improvement.

Operational Features

Obstruction-free Approaches: The dominant obstructions would be the very high Shell building just west of the site, but other high buildings are due to be built north-east and south-west of the station. Of the four approach/take-off funnels which could be provided, no pair are directly in line, and consequently to overshoot would always require a change of direction.

Operational Use: The site is separated from the river by a wide band of continuous development, including St. Thomas' Hospital, the County Hall, the new Shell building, the Festival Hall, the site of the proposed National Theatre and the Royal Waterloo Hospital, and for reasons of safety could not be used by single-engined helicopters. Otherwise, for multi-engined helicopters the general usability in terms of prevailing wind conditions would be nearly 100%.

Amenity Interference

Direct Effects: The heliport would entail considerable redesign and rebuilding of the station itself with consequent interference with its normal running. Safeguarding restrictions could hamper the design of new buildings in this area, which is due for extensive redevelopment, and where there are already a number of high buildings.

Noise Features

Location: There are 4,000 people living within a quarter of a mile and a great number of people working in nearby offices. The sensitive buildings in the vicinity include the Royal Waterloo Hospital, the General Lying-in Hospital, the Royal Festival Hall, the Old Vic Theatre, the County Hall, the new Shell offices, Petrofina and Cornwall Houses, two schools and churches, and, in addition, other office buildings and the National Theatre are due to be built shortly.

Climb and descent would be made over the following:-

1. Landing 012°T/Take-off 192°T:

The main line railway runs roughly along the centre of the funnel, but it is skirted on the west by the proposed extension to St. Thomas' Hospital at 1,500 ft. from the pad and by Archbishop's Park, and on the east by residential areas, which include two schools within 2,000 ft. of the pad.

2. Landing 289°T/Take-off 109°T:

Up to 3,000 ft. from the pad, a predominantly residential area with a school close to the centre of the funnel, and, beyond the main line into Blackfriars Station, further residential areas.

3. Landing 221°T/Take-off 041°T:

After crossing the railway line into Charing Cross Station at 1,000 ft. from the site, a band of mainly residential development with one school directly below the centre of the funnel up to the south bank of the river at 3,000 ft. from the pad.

4. Landing 163°T/Take-off 343°T:

The Shell offices and the Festival Hall gardens within 1,500 ft. of the pad; between 2,000 ft. and 3,000 ft. from the pad, the river Thames; thereafter, King's College and the offices of Aldwych.

Preferential Use of Approaches: All the flight sectors for multi-engined operations would pass over hospitals, residential or office areas while helicopters were at low height.

(6) CHARING CROSS STATION (PLAN VII)

Heliport Layout

Heliport Features: The immediate area of Charing Cross Station, including the nearby Victoria Embankment Gardens, offers no feasible ground level site. A platform would be possible only above the height of the station roof and clear of the railway signals, so that the lowest it could be built would be 64 ft. The railway station width would be inadequate for a fully functional heliport and the platform would have to be extended over the buildings on the east side of Craven Street and the west side of Villiers Street, though not over the roadways themselves. In order to make space for pads for the available approach directions, the heliport platform would have to be further extended over the western end of Hungerford Bridge. The total platform area would then be 7½ acres, which would contain pads and parking space for 7-9 large helicopters. The shape would allow free access between pad and apron. Expansion could only be achieved over the Embankment Gardens or further over Hungerford Bridge towards the centre of the river.

Terminal Facilities: As at Waterloo, the ability to use the space below the operating platform would be limited by the need to keep the railway station in constant use. There would be no accommodation for terminal facilities, unless the buildings at the front of the station were either partly or wholly incorporated in the heliport. The only other space in the vicinity that could conceivably be used would be the area beneath the station arches, but this is already taken up by other activity. The problem of giving service vehicles access to the heliport would be accentuated by the shortage of space at or around the site.

Construction would have to be phased to avoid interference with the normal working of the station. The spacing of supports would require clearance between railway tracks, and, owing to the presence of underground railway tunnels, the question of foundations would have to be carefully examined, especially for the extension over Hungerford Bridge.

Convenience to Traffic

Ease of Access: The site is 10-13 minutes by car from Grosvenor Square and 13-15 minutes from the Mansion House. The Northern, Circle, District and Bakerloo Underground lines, and frequent bus services, place the site in convenient reach of the whole London area.

Road Access: The roads around the station end in the vicinity are very congested and would find difficulty in coping with a substantial volume of additional traffic.

Operational Features

Obstruction-free Approaches: There is a band of high buildings along the northern bank of the river on both sides of the site, and on the opposite bank is the new Shell building. Three take-off and landing sectors would be available, two from the north-east and one from the south. But no direct approach and overshoot path would be possible owing to the predominance of obstructions close to the site and to the bend in the river.

Operational Use: The site, being close to the river, would be accessible to single-engined helicopters. For multi-engined helicopters the two approaches from the north-east are well aligned to the prevailing winds and they would give a usability of just over 98% for landings. The main take-off sector, however, is less favourably placed in relation to the predominant wind, and take-offs would have to contend with a cross-wind component greater than 15 knots on about 5% of occasions.

Amenity Interference

Direct Effects: The presence of the heliport would probably require a number of dwellings in Villiers and Craven Streets to be closed to residential use and turned over to other activity. A high structure extending over the bank of the river would detract from one of the famous views of the North Bank from Westminster Bridge, and its presence would seriously interfere with daylight in the public gardens close to the site. It would be difficult to avoid disruption of railway services during construction. A building under construction at the southern end of Villiers Street would have to be limited to the height of the heliport platform.

Noise Features

Location: There is a large number of people working in nearby offices, and the number is likely to increase in the future. Close to the site are Whitehall Court, the Metropole, Victoria and Adelphi buildings, a hotel at the northern end of the station and public gardens directly alongside. Although at certain points in the vicinity there is quite a high level of background noise, for example, the busy road traffic in the Strand and Trafalgar Square and trains passing over Hungerford Bridge, the area is one where noise could cause serious interference with normal activity.

Climb and descent would be made over the following:-

1. Landing 348°T/Take-off 168°T:

The river, up to 2,000 ft. from the pad, but with the County Hall and other offices and the Festival Hall nearby on the south bank; St. Thomas' Hospital at 2,500 ft.; thereafter, within 4,000 ft. of the site, Lambeth Palace.

2. Landing 215°T/Take-off 035°T:

Roughly along the Victoria Embankment up to 1,500 ft. from the pad; thereafter, Somerset House, King's College and the Royal Courts of Justice up to 4,000 ft. from the heliport.

3. Landing 240°T/Take-off 060°T:

The river up to 2,000 ft. from the pad; but after crossing the river by the Temple, from 2,000-4,000 ft., the office area near the northern end of Blackfriars Bridge.

Preferential Use of Approaches: With landings confined as far as possible to 240°T, the site would still have a 99% standard of usability for multi-engined helicopters: most take-offs would be on 168°T (see obstruction-free approaches). Although these sectors lie over the river for the 2,000 ft. nearest the site, there are a number of sensitive buildings close to their centre-lines.

(7) BLACKFRIARS STATION (PLAN VIII)

Heliport Layout

The Site: The land is zoned for City Riverside purposes and its present use is for warehousing, but there are also a number of offices and areas which have been cleared by war damage. With the exception of a small area belonging to the City Corporation, the site is in private ownership, but the City will probably be acquiring further land for the proposed road works.

Heliport Features: A ground level heliport is not feasible owing to lack of space and the presence of major roads at the same or higher level. The minimum height for a heliport platform would be about 47 ft. and the maximum, governed by the restriction on development around St. Paul's Cathedral, would be about 67 ft. The 6-acre platform possible at 47 ft. would allow a pad and 5 working stands to be in use at the same time, and permit free movement between them.

Terminal Facilities: The ground area within the limits of the new road layout, which will result from the City Corporation's improvement of the northern bridgehead of Blackfriars Bridge, would be about 3 acres, and the height of the flight deck would leave room for 3 or 4 levels to be provided below it to house administrative and terminal facilities. Vehicle access to the heliport would have to be designed to fit in with a complex road junction.

Construction: To build a platform would require bridging over roadways. It is possible that the heliport construction could be phased in with the proposed road works. The proximity of the site to St. Paul's Cathedral would demand that special attention be given to the appearance of the heliport structure.

Convenience to Traffic

Ease of Access: It takes 19 - 24 minutes to reach the site from the West End, but only about 5 minutes to reach the heart of the City. The underground station connects the site with the central area and a number of bus routes pass nearby. The site has the advantage of being close to the main G.P.O. sorting offices.

Road Access: The flow of road traffic in the vicinity will be complicated for the next few years by construction work on the new road scheme. Other roads in the vicinity are very congested during peak and working hours. Most of the traffic from the West End would travel to the site via the Victoria Embankment, which, except for the short length included in the Blackfriars Bridgehead Scheme, is not due to be improved.

Operational Features

Obstruction-free Approaches: Approaches from a wide arc north of the site and from the direction of the Bankside Power Station would be ruled out by obstructions. Direct approach and overshoots would be possible in an east/west direction, and two further obstruction-free approach sectors would be available for use.

Operational Use: The site would border the river but the presence of obstructions such as the railway station and the road and rail bridges nearby would impose restrictions on the use of the site by single-engined helicopters. The usability of all the available flight sectors by multi-engined helicopters would be over 99%.

Amenity Interference

Direct Effects: Disturbance of non-residential activity would result in any event from the proposed road works. It has been assumed that a large 95-ft. high warehouse immediately east of the site would have to be demolished to make way for the new road scheme.

Noise Features

Location: Within a quarter of a mile is a part of the office area of the City containing some 90,000 workers, and St. Paul's Cathedral, two churches, and a boys' school are close to the site. The resident population in this area is 219. Beyond the river, the south bank is predominantly industrial and commercial in character but has a band of residential development about 200 yds. inland.

Climb and descent would be made over the following:-

1. **Landing 044°T/Take-off 224°T:**

Up to 1,000 ft. from the pad, the river and Blackfriars road and railway bridges; thereafter, until passing over Waterloo Station, areas sensitive to noise.

2. **Landing 088°T/Take-off 268°T:**

The north bank of the river, with Unilever House at 1,000 ft., the Inner Temple at 1,500 ft. and King's College at 3,000 ft. from the pad.

3. **Landing 268°T/Take-off 088°T:**

Office activity within 1,500 ft. of the site; for the next 1,000 ft., an area mainly occupied by warehouses, but due to be redeveloped as a residential and office area; thereafter, further offices with a large working population.

4. **Landing 310°T/Take-off 130°T:**

For the 1,500 ft. nearest the heliport, mainly the river; thereafter, mainly riverside or industrial activity, but Southwark Cathedral would be near the centre of the funnel 3,000 ft. away from the site.

Preferential Use of Approaches: With take-offs mostly confined to 224°T, and landings to 310°T, the cross-wind usability for multi-engined operations falls off appreciably to 96%.

(8) CANNON STREET STATION (PLAN IX)

Heliport Layout

The Site: The station itself is zoned for railway use, the area on the east, south of Upper Thames Street for waterside commerce, and north of Upper Thames Street for offices.

(a) The railway station is due to be extensively rebuilt. Planning permission has been granted for a high office block at its northern end rising to about 154 ft. with a U-shaped block extending southwards on stilts about 15 ft. above part of the station roof. Work is already under way. The British Transport Commission have been discussing with the City Corporation the possible use of the station roof as a car park.

(b) The area to the east (Plan IXA) enclosed by the proposed heliport lies in private ownership and has suffered considerable war damage.

(i) South of Upper Thames Street there is one property in full use, Red Bull Wharf, on a site 60 ft. x 350 ft., which divides the cleared land into two plots each about 200 ft. x 350 ft.

Plot 1 immediately adjoins Cannon Street Station. An application has been made to develop this area by the erection of a riverside warehouse and ancillary offices on the Upper Thames Street frontage. The warehouse would be from 44 ft. to 60 ft. high and the office block 114 ft. high.

Plot 2 east of Red Bull Wharf, is due to be developed by the City Corporation as a multi-storey car park for about 500 cars.

(ii) North of Upper Thames Street are two further plots amounting in all to about 2 acres:-

Plot 3, next to the station, is the subject of an application to build a block of offices.

Plot 4 has a valid planning permission dated 19th March, 1959, for a high office building. This permission is subject to the approval of detailed drawings, and the erection of the building does not seem imminent.

Heliport Features: One of the attractions of the site is that, subject to agreement on the part of individual developers, it lends itself to gradual expansion from a small beginning. Should helicopter travel not develop to the scale we have estimated, the heliport could be retained as a small facility to serve the City.

The redevelopment of the station offers the immediate possibility of using the station roof (3 acres) at an average height of 54 ft. above ground: owing to the restriction on high buildings around St. Paul's Cathedral this would be the highest a platform could be raised. By itself, this area would be inadequate for even very limited regular services and the presence of the high office building at the northern end of the station would detract from safety. To provide the necessary space would ultimately require the addition of a raised platform at the level of the station roof over Plot 1, Red Bull Wharf and Plot 2. The platform area would then be 7 acres,* which could contain pads and 7 working stands. In addition, the platform could be extended some way over the river, which would greatly improve the site's operational characteristics, but the cost would be considerable.

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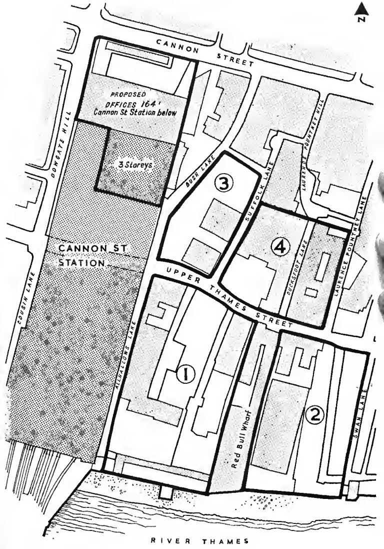
*The same final heliport layout could be achieved with a platform over the station roof and Plots 1, 3 and 4.

PLAN IXA CANNON ST STATION


N
CANNON STREET
PROPOSED OFFICES 164' Cannon St Station below
3 Storeys
DOWGATE HILL
BUSH LANE
③
SUFFOLK LANE
LAURENCE POUNTNEY HILL
LAURENCE POUNTNEY LANE
④
DUCKSFOOT LANE
CANNON ST STATION
UPPER THAMES STREET
COUSIN LANE
ALLHALLOWS LANE
①
Red Bull Wharf
②
SWAN LANE
RIVER THAMES

For both the smaller and larger heliports the shape would allow unhampered movement to and from the operating area. Some form of passenger access below platform level would be needed to the working stands east of the operating area in the larger scheme.

Terminal Facilities: There would be about 12 acres of floor space available which would be more than enough for ancillary facilities. With car parks and offices housed in the extra space beneath the platform, the development would represent an economic use of land from a planning point of view.

Construction: It would be necessary to strengthen the station roof up to heliport standards and build a platform over plots 1, 3 and 4. We have taken advice from the consultant engineers preparing the station redevelopment scheme, who estimate that the cost of strengthening the roof above the normal requirements for the station would be about £350,000. A further £400,000 would be needed to extend the platform over plot 1, and roughly £400,000 for an extension over plots 3 and 4.

Convenience to Traffic

Ease of Access: The site is 23 - 27 minutes by road from the West End and virtually at the heart of the City. Cannon Street underground station is on the site, and a number of bus services pass nearby. The main G.P.O. sorting offices are not far away.

Road Access: Both the Blackfriars Bridgehead and Upper Thames Street are due to be improved before 1967 with further schemes to be put in hand after that date, but no improvement to Victoria Embankment is likely. Since entrance to the site will have to be via Upper Thames Street and most of the traffic will be from the west, the right hand turn into the heliport would cause difficulty.

Operational Features

Obstruction-free Approaches: Among the main obstructions would be St. Paul's Cathedral, about half a mile away, the Monument, the Bankside Power Station and cranes along the river. There are a number of high buildings due to be built in the area north of the station, which, combined with the objections to approaching at low altitude over the densely populated area of the City, would rule out operations in the semi-circle north of the site. Approach and take-off sectors are available over the river, but overshoot procedures would involve an appreciable change of direction in flight. One other line of approach would be possible. An extension of the platform over the river would considerably improve the operational characteristics of the site, albeit at some cost.

Operational Use: The site lies close to the river and could be used by single-engined helicopters, although there would have to be restrictions, particularly in relation to the bridges south-west of the site. The general usability for multi-engined helicopters using all approaches would be 98%.

Amenity Interference

Direct Effects: The roof section of the heliport could be phased in with the station reconstruction. The rest of the area on the east needed for the first scheme is not in use. For the later extension of the heliport some modification would be needed to Red Bull Wharf and to the structure of the proposed City Corporation car park. The eastern end of the heliport would be on the boundary of Swan Lane and might shut out the daylight from a proposed building on the opposite side of the road.

Noise Features

Location: Within a quarter of a mile there are 45,000 office workers and 328 residents; there are also some City churches in this area. The absence of other sensitive buildings would mean that the noise problem would be confined mainly to working hours. There are a number of high buildings in the vicinity of the site which would tend to shield the noise for certain areas, but their full effect would have to be investigated. The south bank is mainly industrial, but contains Southwark Cathedral some 350 yds. from the site.

Climb and descent would be made over the following development:-

1. Landing 085°T/Take-off 265°T:

   The river Thames.

2. Landing 048°T/Take-off 228°T:

   The river up to 1,000 ft. from the pad; thereafter, mainly commercial or industrial areas, which contain a band of residential property 2,000-2,500 ft. from the pad.

3. Landing 303°T/Take-off 123°T:

   The river or mainly industrial areas of the south bank.

Preferential Use of Approaches: The feature of landings and take-offs on all these approach sectors is that they would be conducted away from the sensitive office area north of the site, and at low heights multi-engined helicopters would be over either the river or industrial and commercial areas. With take-offs on 265°T on the majority of occasions, and landings on 303°T, the site has its full 98% usability for multi-engined operations.

(9) ST. KATHARINE DOCKS (PLAN X)

Heliport Layout

The Site: The docks are owned by the Port of London Authority and consist of two basins surrounded by warehouses, some of which are derelict after bombing during the war and some of which are listed as being of architectural and historic interest. In the south-east corner of the docks are two blocks of London County Council flats, Stephen and Matilda Houses.

Heliport Features: We have studied three possibilities; a small site at ground level on the southern edge of the East Dock, a ground-level site over the whole East Basin and one with a platform at 48 ft. over the southern area of the East Dock. We found that neither of the ground-level sites would be acceptable operationally, and a raised platform would be needed for a workable heliport. An 8¾-acre platform could be provided with space for a landing area plus working area plus working stands for up to 9 large helicopters at a time according to the approaches in use. The shape of the platform would allow free movement between the pad and aprons. Expansion of the site might be possible over the East Basin.

Terminal Facilities: The heliport platform would be high enough to allow the use of the area beneath on three levels. The total floor area would be about 21 acres. The heliport itself would require only a small proportion of this space, which could otherwise be devoted to the warehousing activity appropriate to the area.

Construction: The heliport would require the demolition of the two blocks of flats. Foundation problems might also increase the building costs and would need careful investigation.

Convenience to Traffic

Ease of Access: The site is 28-34 minutes by car from the West End, and 10-13 minutes from the City. The nearest underground station is Tower Hill, 10 minutes' walk away, from which it is possible to reach Victoria in about a quarter of an hour.

Road Access: Road improvements in the City are planned for the next twelve years which could be expected to ease the situation for travellers from further afield. East Smithfield is being improved. The Tower Bridgehead is becoming very congested, but there are at present no proposals to deal with this difficulty, which would be accentuated by the additional traffic generated by the heliport. If East Smithfield has to remain a one-way street, which appears likely, the route away from the heliport would be circuitous. If it is possible to introduce two-way working, some provision would be needed for traffic to the heliport crossing the west-bound traffic, possibly in the form of a flyover loop road. No additional space is likely to be available for this on the north side of East Smithfield.

Operational Features

Obstruction-free Approaches: The main obstructions preventing an effective ground-level site would be the towers of Tower Bridge, high warehouses and a large number of cranes, many rising as high as 130 ft. The raised platform only partially overcomes these obstructions, and to give the site adequate approaches the height of some of these cranes would have to be reduced. A south-westerly approach into the prevailing wind with an overshoot path is possible, with a further through approach in a westerly direction. The view from approaching helicopters of the Tower and Tower Bridge would be an attraction.

Operational Use: If cranes on the northern bank of the Thames were removed, limited use could be made of the site by single-engined helicopters. The usability of the site for multi-engined helicopters would be over 99% with the main approach closely into wind.

Amenity Interference

Direct Effects: Rehousing the 800 people living in the flats would be costly. A number of cranes would have to be reduced in height, some very considerably. Otherwise, little disturbance would arise since warehousing activity could be accommodated beneath the flight deck of the heliport, although the work of the docks might be interrupted during construction. If vessels continued to use the East Dock masts and cranes should not exceed platform height and smoke would have to be avoided.

Noise Features

Location: The immediate surrounds of the site are devoted to dock and warehousing activity, but, further away, within a quarter of a mile are the Tower, the Royal Mint and a Peabody housing estate with a resident population of about 400 people. South of the site are the river and waterside activity.

Climb and descent would be made over the following:–

1. Landing 110°T/Take-off 290°T:

Up to 1,000 ft. from the pad, warehousing activity; from 1,000-2,000 ft. the southern precincts of the Tower; thereafter, offices on the north bank of the river.

2. Landing 038°T/Take-off 218°T:

The river, up to 1,000 ft. from the site; thereafter, predominantly industrial areas, but containing some residential property.

3. Landing 290°T/Take-off 110°T:

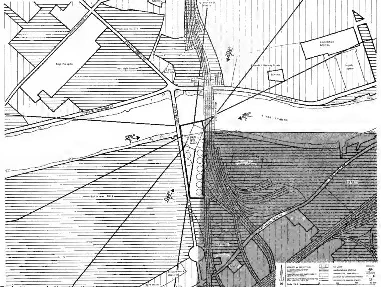
Mainly dock activity up to 3,000 ft. but with some dwellings about 2,500 ft. from the site; thereafter, the river.

4. Landing 218°T/Take-off 038°T:

Industrial and warehousing activity up to 1,500 ft. from the pad; thereafter, mixed residential and industrial activity.

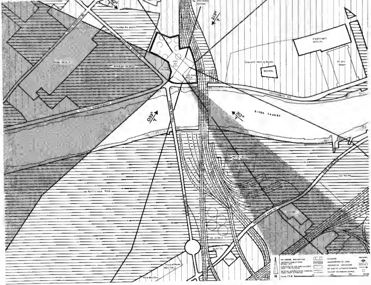
Preferential Use of Approaches: With take-offs mostly on 218°T or 290°T, and landings on 290°T, the site would be usable for multi-engined operations on about 99% of occasions.

PLAN II BATTERSEA WHARF



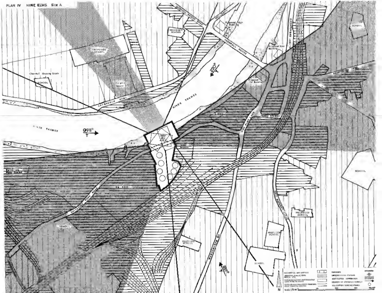
PROPOSED SCHOOL
ROYAL HOSPITAL RD
CHELSEA BRIDGE RD
Royal Hospital
Ranelagh Gardens
L.C.C. Pump House
CHELSEA EMBANKMENT
CHELSEA BRIDGE
SCHOOL
GROSVENOR RD
202° T
256° T
RIVER THAMES
076° T
PAD 80' A.G.L.
022° T
Battersea Park
BATTERSEA PARK RD
N

PLAN III GROSVENOR ROAD

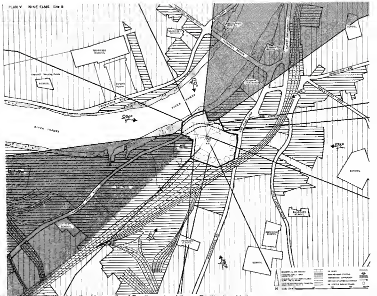


192°
T
PROPOSED SCHOOL
To VICTORIA Station
212°
T
CHELSEA BRIDGE RD
PROPOSED SCHOOL
Churchill Housing Estate
SCHOOL
Do phin Square
GROSVENOR RD
CHELSEA EMBANKMENT
033°
T
CHELSEA BRIDGE
RIVER THAMES
312°
T
Battersea Park
Gas Works
SCHOOL
Gas holders
SCHOOL
SCHOOL
N

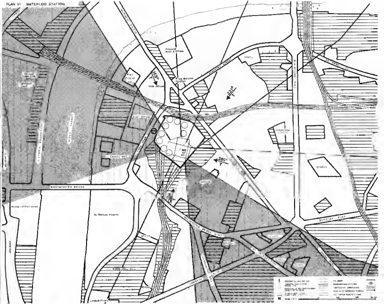
PLAN IV NINE ELMS Site A


PROPOSED SCHOOL
Churchill Housing Estate
SCHOOL
Pimlico Square
GROSVENOR ROAD
VAUXHALL BRIDGE ROAD
PROPOSED SCHOOL
Proposed High Building
VAUXHALL BRIDGE
RIVER THAMES
220°
T
Proposed Road Building
ALBERT EMBANKMENT
Proposed TV Building
SCHOOL
KENNINGTON LANE
RIVER THAMES
098°
T
PAD
NINE ELMS LANE
PASCE STREET
Battersea Park Station
BATTERSEA PARK ROAD
SCHOOL
PROPOSED SCHOOL
PROPOSED SCHOOL
PROPOSED SCHOOL
WANDSWORTH RD
SOUTH LAMBETH ROAD
SCHOOL
PROPOSED SCHOOL
SCHOOL
357°
T
N
RAILWAYS
UNDERGROUND STATIONS
RESTRICTED APPROACHES
HELICOPTER PARKING STANDS
Scale

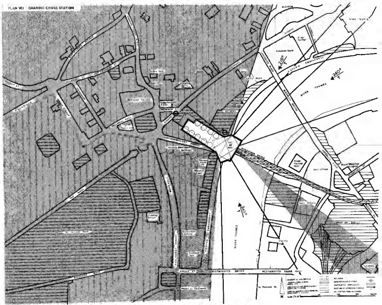
PLAN V NINE ELMS Site B


PROPOSED SCHOOL
Churchill Housing Estate
SCHOOL
Dolphin Square
GROSVENOR ROAD
PROPOSED SCHOOL
VAUXHALL BRIDGE ROAD
MILLBANK
VAUXHALL BRIDGE
ALBERT EMBANKMENT
Proposed T.V. Building
SCHOOL
KENNINGTON LANE
HARLEYFORD ROAD
RIVER THAMES
170°
T
096°
T
249°
T
RIVER THAMES
NINE ELMS LANE
PARK STREET
276°
T
SCHOOL
QUEENSTOWN ROAD
SCHOOL
PROPOSED SCHOOL
020°
T
PROPOSED SCHOOL
WANDSWORTH RD
PROPOSED SCHOOL
SCHOOL
350°
T
N

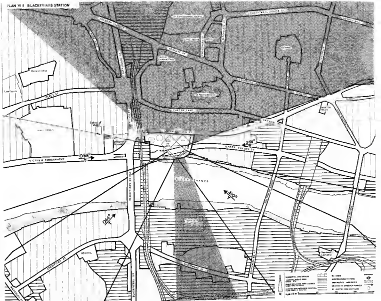
PLAN VI WATERLOO STATION


Proposed Hotel & Offices
163°
T
Shell Offices
221°
T
280°
T
County Hall
River Thames
Westminster Bridge
Houses of Parliament
St Thomas Hospital
Millbank
York Road
Stamford Street
Waterloo Bridge
School
Proposed School
Borough Road
Westminster Bridge Road
Lambeth Road
Lambeth Palace
Underground Stations
N
Scale

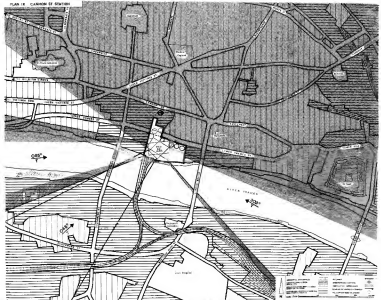
PLAN VII CHARING CROSS STATION

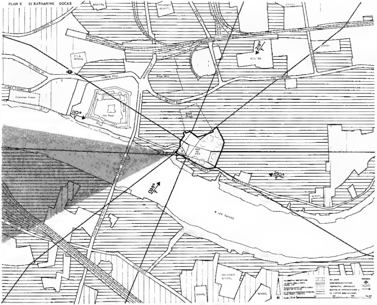

REGENT ST
PICCADILLY
COVENTRY ST
SHAFTESBURY AVENUE
CHARING CROSS RD
HAYMARKET
PALL MALL EAST
STRAND
NORTHUMBERLAND AV
WHITEHALL
PARLIAMENT STREET
VICTORIA EMBANKMENT
BRIDGE ST
WESTMINSTER BRIDGE
WESTMINSTER BRIDGE ROAD
Houses of Parliament
St Thomas's Ho.
County Hall
Shell Offices
Royal Festival Hall
Royal Waterloo Hospital
STAMFORD ST
WATERLOO ROAD
WATERLOO BRIDGE
LANCASTER PLACE
Somerset House
King's College
ALDWYCH
MIDDLE TEMPLE
HUNGERFORD BRIDGE
Savoy Hotel
RIVER THAMES
215° T
240° T
340° T
SCHOOL
N

PLAN VIII BLACKFRIARS STATION


HOLBORN VIADUCT
SHOE LANE
FARRINGDON ST
NEWGATE ST
Central Criminal Court
G.P.O. Offices
ALDERSGATE ST
LONDON WALL
Record Office
Law Courts
FLEET ST
Inner Temple
School of Music
St Paul's Cathedral
CARTER LANE
CHEAPSIDE
POULTRY
Mansion House
CANNON ST
KING WILLIAM ST
QUEEN VICTORIA ST
UPPER THAMES ST
VICTORIA EMBANKMENT
088°
T
268°
T
RIVER THAMES
310°
T
044°
T
BLACKFRIARS BRIDGE
SOUTHWARK BRIDGE
SOUTHWARK ST
STAMFORD ST
SCHOOL
WATERLOO RD
BLACKFRIARS RD
Southwark Cathedral
N
Scale

PLAN IX CANNON ST STATION


TO OXFORD ST
NEWGATE ST
ALDERSGATE ST
Guildhall
MOORGATE
Bank of England
ROUTE 11
BISHOPSGATE
ALDGATE
SCHOOL
CHEAPSIDE
St Pauls Cathedral
TO HOLBORN CIRCUS
QUEEN VICTORIA ST
TO VICTORIA EMB
QUEEN VICTORIA ST
CANNON ST
UPPER THAMES ST
EASTCHEAP
Monument
LOWER THAMES ST
TOWER HILL
The Tower
RIVER THAMES
085°
T
303°
T
048°
T
SOUTHWARK ST
SOUTHWARK BR
SOUTHWARK ST
Southwark Cathedral
BOROUGH HIGH ST
Guys Hospital
LONDON BRIDGE
TOWER BRIDGE
N
UNDERGROUND STATIONS


PLAN X   St KATHARINE DOCKS
SCHOOL
PROPOSED SCHOOL
SCHOOL
SCHOOL
SCHOOL
230°
P.L.A. Building
TOWER HILL
MANSELL ST
Royal Mint
EAST SMITHFIELD
Custom House
110°
The Tower
Boat Dock
St KATHARINES WAY
280°
028°
RIVER THAMES
SCHOOL
SCHOOL
SCHOOL
SCHOOL

SUPPLEMENTARY REPORT

ON THE

HIGH HELIPORT

Introduction

At paragraph 64 of our report, we took note of the suggestion that noise at a heliport could be reduced by building the heliport on a sufficiently high platform. We concluded that a significant reduction of noise by height alone would be impracticable for a number of reasons, not least because the regularity of operations would suffer when there was low cloud and because the cost would be extreme.

2. When we were preparing our report there was little current information about high level heliport platforms. In view of the attractions of the proposal as a way of reducing the duration and level of noise in the immediate vicinity of the heliport and the possibility of exploiting the area underneath as a means of improving the economics of the heliport itself, we were asked to put in hand a more detailed study.

3. If the platform were raised to 600 feet, the noise of the Rotodyne in landing and taking off, as heard by people at ground level in the immediate vicinity, would be reduced by half. We therefore invited consulting engineers, Messrs. Freeman, Fox & Partners, to carry out a preliminary engineering study of a heliport 600 feet high. In particular, they were asked to report on:-

(a) what form of structure would be suitable for the platform and other facilities required for a heliport either alone or in conjunction with other uses;

(b) rough estimates of the cost of these structures, and

(c) the time they would take to build.

Construction Considerations

4. Their report is at Annex A. They found that it was quite practicable to construct a 5-acre operating platform 600 ft. high with a 4-acre deck beneath to house ancillary facilities. Additional floor area could be provided at ground level to meet other heliport requirements, e.g. car parking. Development of the space underneath for other uses would be unlikely to be feasible much higher than 350 ft., and in these circumstances there would be little saving in cost by combining the 600-ft. heliport with the building development. A decision whether or not to provide a building below the platform would therefore rest on the financial contribution that it would be likely to make to the finances of the heliport (see paragraph 8 below).

5. The capital cost of providing a structure 600 ft. high comprising high level platforms, supporting columns, main lift shafts and foundations, and ancillary facilities other than operational equipment, would be about £7,000,000. If the structure were built over railway tracks, the cost would increase by about £300,000. For a 300-ft. platform the cost would be about £6,000,000. The comparative cost at about 70 ft. would be about £3,000,000.

6. With increasing heights of platform, the operating costs of the heliport would be expected also to increase. Additional costs would also arise in carrying passengers, fuel and equipment to the operating platform and maintenance costs would increase. Some savings would be made in helicopter operating costs.

7. If, however, the heliport platform were sufficiently low to form the roof of the associated building, the capital cost of the combined structure would be appreciably less than that of the independent construction of each.

/Economic

Economic Considerations

8. We asked the Chief Valuer of the Board of Inland Revenue whether an associated building development under the platform would subsidise the heliport itself, assuming that it were built at Nine Elms. The estimates he was able to furnish were no more than broad approximations because there were so many imponderables (such as the provision of adequate access and the extent to which proposed development of the surrounding area might be modified by the proposals). He considered that only an office building stood any chance of being remunerative, and he doubted whether such use would be permitted at Nine Elms (a view shared by the Committee – see paragraph 12 below). Assuming a capital cost of £4 million for the building, excluding the cost of the site and the very large cost of providing adequate access, and a permitted site ratio* of 2 : 1, we reached the tentative conclusion that even an office building let at advantageous rents would be unlikely to contribute enough to pay for the extra capital and running costs of building the platform to 600 ft. We have not, however, examined the economics of the less expensive scheme whereby the heliport platform would be the roof of an associated building low enough to be acceptable to the planning authorities (see paragraph 13 below).

Operational Considerations

9. The provision of a heliport on a 600-ft. elevated platform would have the advantage that the alignment of the pads and flight paths could be chosen to suit prevailing wind conditions. Obstacle clearance difficulties would not arise, nor would the height of building development in the region of the site have to be strictly controlled.

10. On the other hand, little is known of the effects of air turbulence at this height on landing and take-off manoeuvres; they could have a significant influence on the regularity, and possibly the safety, of operations. Meteorological data about wind conditions at 600 ft. over central London are not available, but on the basis of data for Heathrow, suitably adjusted, operations from a 600-ft. heliport would probably be impracticable for about 10% of the time because of low cloud and for a further 2% of the time because of strong and gusty winds. Heliport usability of less than about 95% is commercially unattractive; where the usability may be as low as 88% successful commercial operations would be gravely prejudiced. We reached the provisional conclusion that for this reason the operating platform should not exceed a height of about 200 ft.

11. In order to avoid any possibility of reducing the utilisation of Heathrow, traffic patterns for fixed-wing aircraft would have to be independent of those for helicopters operating at a central London heliport. The normal minimum height for fixed-wing aircraft will be about 1,500 - 2,000 ft. to the west of the central London area, increasing towards the east; this would impose an effective operating ceiling of 1,000 ft. for helicopters over central London. The higher the platform, the less room there would be for helicopters to manoeuvre below this ceiling.

Planning Considerations

12. The planning authorities would see objections to the erection in central London of a 600-ft. high heliport of the size envisaged. The three main objections are as follows:-

(a) It would ruin the skyline and cast a shadow over a very large area in the neighbourhood.

/(b)

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* The ratio of covered floor space to total site area.

(b) The permitted site ratio varies from 5 : 1 in the City to 2 : 1 in the Nine Elms area. Large office buildings would not be allowed at either St. Katharine Docks or Nine Elms: warehouses could be built there, but they would not provide a high rental income or warrant a high building. This strengthens our conclusion in paragraph 8 that there is little prospect of subsidising a very high heliport there from the profits of an associated building of any feasible height.

(c) Any large building, particularly one having large numbers of employees or visitors, taken together with a heliport on the same site, would probably give rise to difficult problems of road access and public transport.

An Alternative Approach

13. From the foregoing we conclude that there are serious operational and planning objections and no economic advantages in building to a height of 600 ft. even if we assume the most profitable development of the space below that would be feasible under planning restrictions. There may well be advantages at the chosen site in building as high as possible up to a limit of about 200 ft., at which there would still be a worth while reduction of noise. The precise height can be determined in the light of the more detailed design study that will be necessary when the site has been chosen.

Conclusions

14. (a) A 600-ft. high platform is feasible in engineering terms but would cost about £7 million to build (paragraphs 4 and 5).

(b) There would be only a small saving in capital cost from combining it with an associated building some 350 ft. high which complied with planning requirements (paragraph 4).

(c) An associated building would make no substantial contribution to the revenue of a 600-ft. high heliport (paragraph 8).

(d) Operationally, a 600-ft. high heliport would reduce noise, give freedom in aligning pads and flight paths, and remove safeguarding problems (paragraph 9).

(e) By the same token, however, a platform of this height would not be usable enough of the time and would leave little room for helicopters to fly beneath the approaches to Heathrow (paragraphs 10 and 11).

(f) The planning objections to a 600-ft. high platform at any of the three sites would be very great or insuperable (paragraph 12).

(g) A platform about 200 ft. high would be about £2 million cheaper, could be more profitably associated with another building, and would be less objectionable on visual amenity grounds. It would confer less advantage in noise reduction and the alignment of pads and flight paths, but it would be more usable and would still remove most of the safeguarding problems.

(h) The advantages of building high within the limits outlined in this report should be taken into account at the engineering design stage.

June, 1961

Report on a preliminary examination of the proposal for a High Elevated Platform

March, 1961.

Freeman, Fox & Partners,
Consulting Engineers,
25, Victoria Street,
Westminster,
London, S.W.1.

LONDON HELIPORT

Report on a preliminary examination of the proposal for a High Elevated Platform.

1. On the basis of our discussion and exchange of letters with you in February, we have carried out a preliminary study of the problems presented by the construction of a heliport with an elevated platform at a height of 600 feet.

2. We have assumed that the platform should have an area of 5 acres, which is within the limits of size given in your instructions to us. This area would suffice for the landing pad and part of the apron stated to be required for a capacity of 25 movements per hour. To provide the remainder of the apron area, and the apron facilities and other necessary accommodation at the high level, we have assumed that a second deck about 4 acres in area and 50 feet below the level of the main platform, would be acceptable, the two decks being linked by aircraft carrier type lifts. This difference in height is sufficient to give a clear headroom of 25 feet above the lower deck. More clearance could easily be provided by increasing the difference in height. Within the size limits of the lifts, helicopters would be moved to the lower deck for unloading, servicing, parking and reloading. The total area of platform provided on the two floors at the high level, after deducting lift space and other necessary "dead" areas, would thus be approximately 9 acres. The remaining heliport requirements would, we have assumed, be provided at or near ground level, depending on the form of the structure used to support the high level platform. In Appendix A to this report is a schedule of the floor area requirements that we have assumed.

3. The structure used to support the high level platforms and associated lifts and services may either be one designed solely to fulfil that purpose, (the only buildings etc. at ground level being those required for the heliport,) or it may be a dual purpose structure designed from the outset as the combined framework of a building development and of the high level platforms etc.

4. From a preliminary examination it appears that only a small overall economy in construction cost is likely to be achieved by combining the heliport structure with a building development, compared with the cost of constructing the two things separately and in isolation. The amount of the saving will depend upon the extent of the building development, but as a rough approximation we should expect the percentage saving in cost of the heliport structure to lie somewhere between 5% and 10%, without any consequential increase in cost of the building development. Our reasons for coming to this opinion are explained in more detail in Appendix B to this report.

5. We do not mean to imply that there would be little to gain by a building development. The potential value of a building development is outside the scope of this report. But in our view the problem of determining the optimum type and cubic content of a building development on the site is basically the same as it would be without the heliport. The form of a development would however be influenced by the need for satisfactory aesthetic quality in the combined structure. This would influence the height, form and extent of the development.

Advantage might be taken of the large covered area provided by the high level platform for the provision of special sports, recreation, exhibition or similar facilities.

6. Accordingly we have considered the following questions:-

(a) What would be the order of cost and time of construction of a structure whose sole function would be that of a heliport, with the necessary high level facilities and access thereto, and the remaining facilities at its base?

/(b)

(b) What is likely to be the limitation of height, from a technical or economic point of view, of a building development combined with the proposed heliport?

7. We have assumed an octagonal plan form for the elevated platform. This is structurally suitable and presents virtually the same aspect to approach from any direction. A circular shape would probably be equally economical structurally and could be adopted if operationally superior. Elongated rectangular shapes would be less economic. As already explained, we have allowed for two elevated platforms, the upper one being designed for the ultimate helicopter pad loading and the lower one for the corresponding apron loading. A clear headroom of 25 feet and a clear span of 100 feet between outer and inner columns has been allowed to permit helicopters to be manoeuvred on the lower platform.

Allowance has also been made in the loading for apron service facilities, lifts, fuel storage and other heliport requirements at this high level.

The supporting structure is assumed to be designed in box-form or tubular welded steel as being the material likely, in our opinion, to lead to maximum economy. We do not however rule out the use of pre-stressed concrete as being more suitable for certain parts of the structure. A central tower is provided to contain lifts and other services and a building at or near the ground to contain the low level facilities, driveways, car parks, bus station, shops, restaurant, etc. etc.

Large diameter bored piles arranged in groups under each column would afford satisfactory foundations for such a structure and we have assumed this type of foundation in the estimate given below.

Sketches showing the layout and a perspective view of the suggested structure are attached. We emphasise that within the time available no particular attention has been paid to aesthetics. We consider however that such modifications as would be necessary to meet aesthetic requirements would not materially affect the cost of the structure and the estimate given below may therefore be considered adequate for present purposes.

8. The cost of this structure comprising high level platforms, supporting columns and bracing, main lift shaft, emergency stairs and foundations on a normal clear site in London, (based on approximate quantities derived from a very preliminary outline design) is estimated notionally as £5,000,000.

To give some idea of the total cost of the heliport, we suggest the following allowances for non-structural items:-

(i)	interior finishings at high level. (at 10/- per cu.ft. of enclosed space)	£ 200,000
(ii)	low level buildings complete including finishings (at 12/- per cu.ft.)	£ 300,000
(iii)	multi-storey car park	£ 400,000
(iv)	services (lifts, air-conditioning, water, fire-fighting, electricity, telephones)	£1,000,000.

The estimate does not include the cost of operational equipment, or facilities for the storage, handling or pumping of aircraft fuel or terminal facilities for any railway extension to the site. If the structure were built over railway tracks we should expect the additional cost to be of the order of £300,000.

If the height of the elevated platform were reduced from 600 ft. to 300 ft., as has been suggested by you, we should expect the total cost of the structure to be reduced to about £4,000,000. The cost of services would be reduced to about £900,000, but the cost of other non-structural items would remain the same.

/We

We consider that the time required for construction would be 3 to 4 years.

9. In our consideration of the second problem, the limiting height of a building development, we have paid some attention to the Report of the Committee on High Buildings in London (High Paddington). The site area of the latter, 18 acres, is comparable to that of Nine Elms (B) site of 13 acres.

With high buildings constructed on London Clay, limitations on weight and hence height are imposed not so much by the bearing capacity of the clay as by the need to restrict future settlement of the building and its surroundings to an amount which will not cause significant damage to adjoining property. Clay is a compressible material, but the compression resulting from an imposed load, such as the weight of a building, does not all take place as soon as the load is applied. It goes on increasing for many years. The compression, or settlement, can be limited by constructing box foundations (i.e. deep basements), and so reducing the net additional bearing pressure on the clay. A limit of depth is reached, however, not for technical reasons but because the cost of basement construction becomes excessive. The height of a building is thus usually limited by economic considerations which depend upon the cost of land, the type of development, and other factors. In the case of High Paddington, this limit was judged to be about 350 feet. As a first approximation it may be assumed that the limit in the case of the Battersea site would be of the same order, although a greater height could be achieved if the expense was justified by special considerations.

In view of our conclusions in para.4, we do not think it would be desirable from a purely economic point of view to exceed a height of approximately 350 feet with a building development on the heliport site.

If a plot ratio of 2½:1 is applied to the Nine Elms (B) site of 13 acres, the permissible floor area of development amounts to 32 acres. If 12 acres of this are allowed for heliport purposes, then 20 acres remain available for a building development. The cost of a multi-storey building development of this size for office or residential purposes would be of the order of £4,000,000 excluding the cost of land.

APPENDIX A.

SCHEDULE OF ASSUMED FLOOR AREA REQUIREMENTS

		ITEM		AREA SQ. FT.	REMARKS
High Level Facilities	Upper Plat-form.	Pad	Allow 400' x 200' in any direction Say 400' x 400'	160,000	Total 220,000 sq.ft. or 5 acres.
		Apron		60,000	
	Lower Plat-form.	Apron	To make up total pad and apron area of 330,000 sq.ft.	110,000	Access by lift from upper platform.
		Apron Services	Fire Service equipment, apron vehicles, fuel store and other vehicles.	20,000	Total 165,000 sq. ft. or 3.8 acres
		Build-ings.	Customs 5,000 Immigration 1,000 Waiting 10,000 Observation 5,000 Air control Telecom. Navigation Meteorology 4,000 Concourse 10,000	Total 35,000	
Low Level Facil-ities		Build-ings.	Customs 5,000 Concourse 20,000 Freight 5,000 G.P.O. 2,000 Bonded Stores 5,000 Restaurant 3,000 Staff 2,000 Aircrew 1,000	Total 43,000	Total 184,000 sq.ft. or 4.2 acres
		Car Park.	Long term Short term 100,000 G.P.O. and Service Vehicle Park 8,000 Staff 33,000	Total 141,000	

APPENDIX B

The Economic Advantage of Combining the Heliport with a Building Development

1. The components of the heliport structure supporting the platforms at high level would be:-

   (a) Beams supporting these platforms.
   (b) Columns in direct compression.
   (c) Bracing to the columns.
   (d) Foundations.

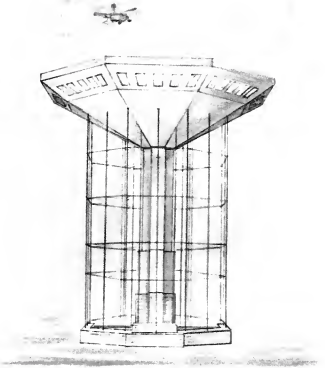
2. If this structure were combined with a building development, the effect on the cost of the above components of the heliport structure only would be as follows:-

   (a) and (b) would be virtually unaffected.

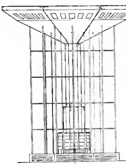
   (c) would be reduced because of the stiffening effect of the building.

   (d) would be increased because of the need to restrict the amount of settlement which would be acceptable on a building development and also because of the increase in intensity of loading on the soil.

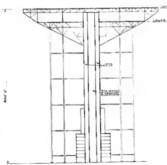
3. The net effect on the cost would, in our opinion, be to make a small saving. The extent of the saving would depend on the extent of the building development. As the height of the development is unlikely to be more than about 350 feet we should not expect the saving to be more than 5 to 10 per cent of the cost of the heliport



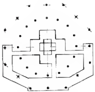
PROPOSED HELIPORT.



ELEVATION

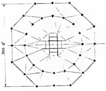

TOP DECK 600 LEV.
LOWER DECK 550 LEV.
LIFTS
STAIRCASE & SERVICES
600' 0"

SECTION



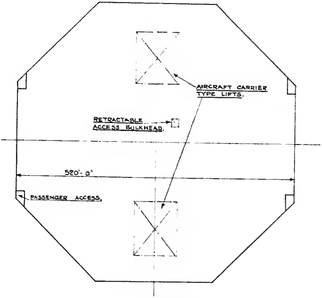
PLAN AT GROUND LEVEL

SCALE 1" 100 0

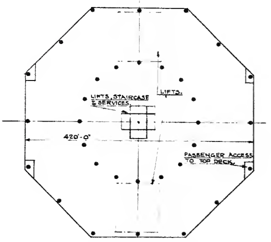


PLAN AT 250' LEVEL.

SCALE 1" 100 0


AIRCRAFT CARRIER TYPE LIFTS.
RETRACTABLE ACCESS BULKHEAD.
520'- 0"
PASSENGER ACCESS.

PLAN OF TOP DECK.


LIFTS, STAIRCASE & SERVICES.
LIFTS.
420'-0"
PASSENGER ACCESS TO TOP DECK.

PLAN OF LOWER DECK.

SCALE 1" = 100'-0"

DS 92845/1 WT 2655/K 12 7/61 DL